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Abbreviations

AAO	Assistant Agricultural Officer
AICRP	All India Co-ordinated Research Project
AICCIP	All India Co-ordinated Crop Improvement Project
ANGRAU	Acharya N G Ranga Agricultural University
AO	Agricultural Officer
APSSDC	Andhra Pradesh State Seeds Development Corporation
ARIS	Agricultural Research Information System
AS	Agricultural Supervisor
CAPART	Council for the Advancement of Peoples Action and Rural Technology
CAZRI	Central Arid Zone Research Institute, Jodhpur
CGIAR	Consultative Group for International Agricultural Research
CPR	Common Pool Resources
CRIDA	Central Research Institute for Dryland Agriculture, Hyderabad
CSIR	Council of Scientific and Industrial Research
CSSRI	Central Soil Salinity Research Institute, Karnal
CSWCR&TI	Central Soil and Water Conservation Research and Training Institute, Dehradun
DAC	Department of Agriculture and Co-operation
DoA	Department of Agriculture
DOR	Directorate of Oilseeds Research, Hyderabad
DST	Department of Science and Technology
FPR	Farmer Participatory Research
FTC	Farmers Training Centre
GIS	Geographic Information System
GO	Government Organisation
GoAP	Government of Andhra Pradesh
GSSS	Gayathri Shiksha Sadan Sansthan, Udaipur
IFPRI	International Food Policy Research Institute, Washington
IGFRI	Indian Grassland and Fodder Research Institute, Jhansi
IPM	Integrated Pest Management
IVLP	Institute Village Linkage Programme
KSK	Kisan Seva Kendra

KVK	Krishi Vigyan Kendra
MANAGE	National Institute for Agricultural Extension Management, Hyderabad
MWR	Micro-Watershed Rehabilitation
NAARM	National Academy of Agricultural Research Management, Hyderabad
NARP	National Agricultural Research Project
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NCAP	National Centre for Agricultural Economics and Policy Research, New Delhi
NDRI	National Dairy Research Institute, Karnal
NGO	Non-Government Organisation
NORAD	Norwegian Development Agency
GDI	Overseas Development Institute, London
PEW	Para Extension Worker
R&D	Research and Development
SAU	State Agricultural University
SMS	Subject Matter Specialist
T&V	Training and Visit (Extension)
VEW	Village Extension Worker
ZRS	Zonal Research Station

Foreword

This report represents the culmination of one topic of the wider ICAR study on Sustainable Rainfed Agricultural Development in India, funded by a Japanese grant managed by the World Bank. The purpose of this component has been to analyse the major strengths and weaknesses in the institutional and socio-economic dimensions of the work of selected research and extension organisations concerned with rainfed farming in India and making recommendations on how these dimensions can be strengthened.

Several studies have pointed out to the need for improving the research and extension effectiveness in rainfed areas. But few have looked at these issues from the point of implementation. This Policy Paper is one in this direction. The authors have concluded that there is a major scope for improving the Organisation and management of technology provision for rainfed farming, and that greater social science skills are a foundation of such improvements. The authors have also suggested strategies on how the needed changes in research and extension systems could be implemented.

We hope this report would be highly useful for all those concerned with making constant improvements in the working of research and extension systems.

November, 1998
New Delhi

Dayanatha Jha
Director

Preface

In recent years, there has been an increased concern that agricultural research and extension should become more participatory to ensure that the interest of the clients is properly accounted for. This is especially so in marginal, rainfed areas with diverse agro-climatic and socio-economic constraints. The main task of authors has been to analyse the institutional and socio-economic issues in organising appropriate research and extension approaches for rainfed areas and to provide recommendations on needed changes.

We have approached this study by first making a detailed review of the existing reports and recommendations on the above themes and by conducting a wide range of interviews with Directors and senior staff of ICAR Institutions, SAUs, KVKs and State Departments of Agriculture during 1996-97.

The paper examines research and extension from implementation perspectives. It goes into the fundamentals of why implementation of good ideas has been uneven in the past, identifies what constraints can be removed and how, and describes how to sideline those which cannot easily be tackled. The emphasis has been on bringing forth recommendations that can be put into effect in face of these constraints. Further important changes in the external environment facing extension, research and linkages, have occurred in the last two decades. The paper draws on these in arriving at its recommendations.

November, 1998

John Farrington
Rasheed Sulaiman V
Suresh Pal

Acknowledgements

This study forms a part of the component on Improved Watershed and Area Development Strategies in Rainfed Areas (managed by International Food Policy Research Institute, Washington), of an ICAR Research Project on Sustainable Rainfed Agriculture Development, financed by the Japanese grant made available to the Government of India. This support is gratefully acknowledged.

We are grateful to the members of the Steering Committee of the Project [Drs. G.B Singh and Mruthyunjaya (ICAR), Deepak Ahluwalia (World Bank), A.N.Sarkar (Ministry of Agriculture), M.K.Mathur (Planning Commission), G.Ramakrishniah (Ministry of Rural Development) and Dayanatha Jha (NCAP)] for giving broad guidelines for the study and also to the Directors and senior staff of the ICAR institutions, who have shared their experience and insights. The institutions include, CSWCR&TI, CRIDA, CAZRI, NDRI, CSSRI, PDCSR, DOR, NAARM and the three KVKs (Youth for Action, Mehboobnagar; Vidya Bhavan Society, Udaipur; and Agricultural Development Trust, Pune).

We are also grateful to the Vice-Chancellor and senior staff of ANGRAU and RAU; Head, Zonal Research Station (Palem, Hyderabad); Head, National Seed Project (Rajendranagar); Director General, MANAGE; Managing Director, APSSDC; Directors of State Department of Agriculture (Andhra Pradesh and Rajasthan) and Additional Director of Agriculture (Extension), Maharashtra, for their interaction with us and in offering all the necessary help and co-operation.

Drs.Peter Hazell and Ruth Alsop (IFPRI); Derek Byerlee and Deepak Ahluwalia (World Bank); Mruthyunjaya (ICAR); V.V.Sadamate (Ministry of Agriculture) and Dayanatha Jha (NCAP) were kind enough to comment on an earlier draft of this report. We are highly grateful to them. Thanks are also due to Mr. Paul Mundy for the type setting and editing of this document and to Ms. Umeeta Ahuja for the final presentation. The institutional support provided by the NCAP and ODI, for this study is also gratefully acknowledged.

Authors

EXECUTIVE SUMMARY

1. Background

Rainfed farming poses particular challenges for the organisation of research and extension:

- The wide diversity among agro-ecological and socio-economic conditions makes it difficult to focus research.
- Low capital resources and irregular rainfall make farmers perceive intensification as risky in many areas.
- Rainfed farmers are politically and economically marginalised, have low levels of education and self-confidence, and limited ability to articulate their technology needs.
- Markets for individual inputs are small and fragmented, making the commercial sector unwilling to become involved.
- Government staff are reluctant to be posted to many rainfed areas; staff turnover is rapid, and the number of vacant posts is high.

The point of departure of this paper is that under such conditions, healthy, problem-focused and client-oriented research and extension systems rely on strong socio-economic inputs and on a sound institutional base. A dynamic and client-focused research and extension system will generate enthusiasm and self-esteem among those responsible for interacting with clients, and so will create a climate for stronger linkages among researchers, extension workers and intended clients. This paper draws on a large number of existing reports and on interviews with directors and senior staff of ICAR, KVKs and state agricultural universities.

The paper outlines opportunities for stronger social-science skills and institutional analysis in relation to research (=> Section 2 (Section numbers refer to the main body of the report.)), extension (=> Section 3), linkages (=> Section 4), technology supply for rehabilitated watersheds (=> Section 5) and seed supply (=> Section 6).

Overall, ICAR has at its disposal a large number of solid reports, recommendations, guidelines and ideas for improvement in the organisation of research, but their implementation is uneven.

Recommendation 1: As a priority, pursue the implementation of prior recommendations. The majority of recommendations in this paper will be fruitless unless attention to improved implementation is greatly strengthened throughout the system.

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Social-science skills need to be more fully incorporated into the design and implementation of research and extension to:

- Understand how the complex, diverse and risk-prone nature of much rainfed farming constrains some technology options and creates demand for others.
- Guide technological change towards environmental and institutional sustainability.
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- Assist research directors at strategy, programme and project levels in responding to new demands for research and to growing self-earning requirements.

Recommendation 2: Over a 5-year period, increase ICAR's allocation for social sciences and statistics from 0.7% of its budget to 5.0%. Increase the number of social scientists, and employ more senior social scientists. Organise regular interaction among the social scientists to promote cross-learning. Biophysical scientists should develop skills in some areas of concern to social scientists (needs assessment, the understanding of risk, and so on).

=> Sections 1.3, 2.7

2. Strengthening the Organisation and Management of Research

The discussion in the main body of this paper highlights a number of constraints in the organisation and management of research which must either be addressed directly or circumvented, if the efficiency and relevance of research is to be enhanced. These include the following.

Enhance the willingness of research staff to identify and respond to clients' needs. This is the top priority problem facing the organisation of research, and poses some of the most intractable challenges. Only limited progress can be made with all the other recommendations in this paper unless these implementation challenges are met first.

Recommendation 3: Introduce merit-based promotion, and redefine staff-appraisal and performance criteria to reflect client-orientation more strongly.

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Reward systems. High staff turnover in remote areas is a frustrating problem in both research and extension. Solutions to this must be found in the staff-reward system.

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- Scheduling specified areas as remote, and then strengthening telecommunication, staff housing and other facilities.
- Upgrading financial and other incentives for serving in remote areas.
- Developing a transparent and sound transfer policy, specifying the minimum number of years of service in those locations, and implementing this policy rigorously.

=> Sections 2.2, 3.2

Fine-tune the financing of research. Financial mechanisms produce a more direct response to policy initiatives than do any number of guidelines or co-ordinating committees. Reliance on them (in both research and extension) is therefore bound to increase, and is to be welcomed. However, to be fully effective they have to be accompanied by greater stakeholder control, improved monitoring of the performance of public-sector employees, and the translation of this into performance-related rewards. Furthermore, conditions specific to rainfed areas have to be taken into account if they are to operate effectively.

Recommendation 5: Increase the self-earning requirement of research institutes and universities, and raise the proportion of research conducted under contract funding. Establish appropriate monitoring systems, and change regulations governing recruitment so directors can engage contract staff, taking full advantage of these provisions.

=> Sections 2.6, 2.7

Some consolidation and rationalisation of research infrastructure is required to save costs and improve efficiency, particularly in the large number of regional or sub-stations operated by the ICAR centres and the SAUs. Cost savings in this area will contribute towards a further desirable goal: more adequate funding for the operational costs of research. The demand for operational funds will rise substantially if more research is to be done on farmers' fields.

Recommendation 6: In those parts of the ICAR and the SAUs concerned primarily with rainfed farming, raise the funds available for operational expenses to at least 30% of overall expenditure.

=> Sections 2.4, 2.7

Recommendation 7: The ICAR and the governments of the principal rainfed-farming states should jointly review research infrastructure with a view to rationalising it.

=> Sections 2.3, 2.7

Recommendation 8: Even out the flow of funds to research institutes over the financial year, so that a steady flow of research can be conducted.

=> Section 2.4

Enhancing the complementarity between ICAR and SAU research. Only limited gains in complementarity can be expected from formal provisions and over-arching plans. However, gains can be expected from stronger research-information systems. For instance, requiring scientists to use such information systems to demonstrate that their proposals take account of other research would reduce overlaps at the project and programme level. Improved research-information systems and wider access to email will help to breakdown current widespread isolation in ICAR institutes and SAUs. Movement in this direction depends largely on changes in incentive and reward systems and on the quality of research management.

Recommendation 9: Implement as soon as possible the AICRP-Review Committee's criteria for prioritising areas for funding, and its suggestions on the continuation and organisation of AICRPs.

=> Section 2.3

Recommendation 10: Make research-information systems and telecommunications (especially email) more fully operational and reliable, among even the more remote research stations.

=> Section 2.7

Allow problem-area focus to influence the structuring of programmes within institutes. A research institute organised entirely on a discipline or commodity basis lends itself to research that derives largely from the scientists' own preferences. By contrast, one organised largely on the basis of carefully prioritised problem areas encourages disciplines to be drawn into addressing clients' problems.

Recommendation 11: Organise at least one-third of research resources on a problem-area basis.

=> Section 2.7

Strengthen project-cycle management. Major opportunities exist for strengthening the research project cycle. At the preparation stage, clients need to be identified more clearly, and a careful needs diagnosis conducted. Researchers should be able to use a computerised database to locate their own proposals in relation to other studies. Proposals should indicate the anticipated economic and social impacts of the proposed research. The proforma for proposals should be modified to accommodate these items.

Recommendation 12: Strengthen the management of the research-project cycle to make it more client-oriented and to make the relationship between activities, outputs and purpose more transparent. Introduce a logical framework (logframe) approach to planning and management.

=> Section 2. 7

Procedures for the approval of research projects need to be strengthened. In most cases, ICAR scientific research committees consist only of the full complement of research staff. This has three negative consequences: (i) it is difficult to reject proposals in this forum (since the authors of the rejected proposals would lose face); (ii) disciplines such as the social sciences are currently under-represented on the committees; and (iii) clients are poorly represented. As research becomes more client- and problem-focused, client representatives (eg, the commercial sector, NGOs, farmers' groups) should become more heavily involved in governing it. This implies a stronger hand in commissioning and monitoring research, and evaluating both research projects and the performance of individual scientists.

Recommendation 13: Strengthen stakeholder; involvement in the approval of research projects and in their governance.

=> Section 2.7

The implementation of projects can be greatly strengthened. There must be continuing consultation with clients as the research progresses. For many types of research, experiments should be conducted on farmers' fields and with the strong participation of farmers. The progress of projects-especially the longer ones- against objectives should be monitored carefully.

At the review stage, lessons for further work need to be drawn out, and feedback from clients should be encouraged and acted upon.

Recommendation 14: Make the implementation of research projects more participatory, monitor them more closely, and draw out lessons more fully.

=> Section 2.7

Develop human resources. The changes outlined above require scientists to master new skills. These include:

- Needs-assessment techniques, including the role of such techniques as participatory rural appraisal.
- The preparation of research proposals, including logframe formats if, as recommended, these are adopted by the ICAR.
- Management of the research-project cycle, from preparation through implementation to review, including the conduct of participatory, on-farm research and the eliciting of feedback from farmers.
- Understanding of farmers' risk-averting practices and their implications for the design of research and the formulation of recommendations.
- Improved understanding of current neo-liberal concepts on the roles of government, commercial and non-profit organisations in technology generation and dissemination for low-resource farmers.
- The preparation and management of research and service contracts with commercial organisations and NGOs; the management of patenting, licensing and royalty arrangements.
- Modes of working in multi-organisation partnership with research and extension agencies within and outside the public sector.

Recommendation 15: Strengthen scientists' skills in a number of areas to promote client-orientation: needs-assessment, proposal preparation, project-cycle management, indigenous knowledge, the roles of government, non-government and private sectors, contracts and patenting, and working in partnerships.

=> Section 2.7

Recommendation 16: Revise the curricula used by education and training institutions to ensure high standards of training in these areas. Provide in-service training for current scientists. Ensure that the faculty of the organisations concerned are up-to-date with the issues and have adequate training materials.

=> Section 2.7

Recommendation 17: Organise programmes to exchange scientists between ICAR institutes and commercial organisations and the larger technology-oriented NGOs.

=> Section 2.7

3. Strengthening the Organisation and Management of Extension

The recent growth in radio, television and video in many villages, and advances in farmer-to-farmer extension approaches, offer opportunities for new approaches to extension.

Recommendation 18. Try out new approaches to extension which rely less on face-to-face contact between 'extension agents and farmers, and more on innovative vehicles (such as mass media) and on support of farmer-to-farmer information exchange.

=> Section 3.4

Much of the extension service is currently driven by targets and restricted to the varieties of crops that have been officially released.

Recommendation 19: Increase flexibility so that extension workers can focus more on identifying farmers' requirements and responding to them.

=> Section 3.4

Training is currently conducted in three different types of organisation (the SAUs, the KVKs and the departments of agriculture), leading to gaps and overlaps. The curricula of training courses should be modified to cover the complexity and diversity of rainfed farming, needs-assessment methods, the conduct of on-farm trials, the assessment of risk, the understanding of risk-averting techniques, working in multi-organisational partnership in research and extension, group formation, the development of leadership skills, conflict resolution, etc.

Recommendation 20: Set up a joint committee at the state and district levels with representations from SAUs, KVKs and Department of Agriculture to streamline and strengthen extension staff-training procedures.

=> Section 3.4

4. Strengthening Research-Extension Linkages

Implementation of the above recommendations for strengthening rainfed research (=> Section 2) and extension (=> Section 3) will strengthen the client-orientation of both, create space for demand to drive the agenda, and so stimulate both existing and new linkages between research and extension.

The public sector faces chronic problems in the provision of extension services to many rainfed areas, given the rapid turnover of extension staff and the high proportion of vacant posts at any one time. Recognising this generates scope for reform.

Recommendation 21: Introduce more widely innovations in research-extension linkages, including multi-agency approaches to extension and the wider use of para-extension workers.

=> Section 4.3

Responsibility for much agricultural research lies with the centre, whereas extension is principally a state subject. The state-centre divide thus cuts squarely across research-extension linkages. ICAR understandably seeks to show that its technologies are working in the field. Its funding for extension activities under its own control (including the KVKs and IVLP) has increased over 12% of its budget. In view of the states' major responsibility for extension, and the need for a limit to the funding ICAR devotes to extension, alternative funding for the KVKs should be sought. Some KVKs do not perform adequately, and there are overlaps and gaps between the KVKs and farmer training centres. The current system of All India Co-ordinated Research Projects needs streamlining, and research by ICAR and the state agricultural universities should take previous and current research elsewhere into account. These changes will increase demand on the research-information system.

Recommendation 22: Limit ICAR funding of its own extension activities to 10% of the ICAR Plan budget.

=> Section 4.3

Recommendation 23: Together with relevant state governments, review KVKs and farm training centres individually against their mandates. Close or relocate those performing poorly. Rationalise the KVK/FTC system to minimise gaps and overlaps.

=> Section 4.3

Recommendation 24: Slim down and reinvigorate AICRPs to generate technologies of interest to the states, which they can then adopt and utilise into their own extension services.

=> Section 4.3

Recommendation 25: Tighten organisation and management in the SAUs. All research proposals should take account of other recently completed or on-going research, including that of the ICAR institutes, to increase the prospects of one drawing upon the other.

=> Section 4.3

Recommendation 26: Make the bibliographic and project-management-system databases more comprehensive and reliable, and train researchers how to use them.

=> Section 4.3

5. Enhancing Technology Support for Rehabilitated Micro-Watersheds

Micro-watershed rehabilitation is a specific feature of rainfed areas, and offers scope for enhanced productivity of crops and livestock, requiring varieties and management practices unfamiliar to farmers. This offers particular scope for new technologies provided through research and extension services. To do this efficiently, several preconditions need to be in place.

Recommendation 27: Co-ordinate technical options for micro-watersheds on a participatory and "system" basis. Funds for contracting research must be in the hands of agencies implementing micro-watershed rehabilitation; they must be able to ensure that research and extension are conducted in a problem-focused and participatory way.

=> Section 5

Recommendation 28: Research and extension services should draw on social-science skills in the micro-watershed context, to understand -farmers' risk-avoiding practices, institutional issues relating to sustainability, and how to combine enhanced productivity with distributional equity.

=> Section 5

6. Enhancing the Spread of Technology Embodied in Input Supply: The Example of Seed

The opportunities in this area are many, of great economic potential, and ripe for exploitation. Several opportunities suggest themselves:

Recommendation 29: Establish a comprehensive and regularly updated database of the characteristics (and sources of seed) of released varieties.

=> Section 6.3

Recommendation 30: Relax procedures for varietal release in individual states (by the public, commercial and voluntary sectors) to allow easier and quicker release of materials bred for similar agro-ecological conditions in other states. Consult the private sector and NGOs on how to improve release and certification procedures.

=> Section 6.3

Recommendation 31: Conduct plant-breeding or varietal-selection trials on-farm rather than on-station. This will close the gap between what breeders produce and what farmers want. Develop a set of criteria for testing and release which includes such indicators as fodder value, cooking and processing quality of grain, and so reflect more closely farmers' own criteria.

=> Section 6.3

Recommendation 32: Study farmers' practices to avoid the risk of drought in semi-arid areas. Incorporate these into breeding and selection procedures.

=> Section 6.3

Recommendation 33: The public sector should continue as a provider of seed where private markets are poorly developed, but its role should gradually shift to that of regulator and facilitator of productive activity.

=> Section 6.3

Recommendation 34: Test and promote a wide range of seed-supply options in semi-arid areas, including those involving the NGOs and farmers' groups.

=> Section 6.3

Recommendation 35: Facilitate, regulate and monitor wider use of truthful labelling.

=> Section 6.3

Recommendation 36: Thoroughly review the regulatory framework for possible improvements in varietal release, plant breeding and seed-supply systems.

=> Section 6.3

7. Nature of Issues

Our recommendations can be divided roughly into three general types of issues: generic (affecting the research and extension system as a whole), organisational (relating to the internal organisation of the research and extension systems), and methods and approaches (concerning the methods used in research and extension). Each of these categories can be further subdivided. Table 1 summarises our recommendations according to these three categories.

Table 1 : Summary of recommendations by type of issue

Recommendation No.		=> Section
A. GENERIC ISSUES		
Strengthen problem focus of research design and devise mechanisms for improving the project management cycle		
1	Implement previous recommendations.	1.1, 8
2	Make project-cycle management more client-oriented and transparent.	2.7
Resolve chronic problems in reward systems, merit promotion, transfer, staffing, etc		
3	Introduce merit-based promotion, and redefine staff-appraisal and performance criteria to reflect client-orientation.	2.5, 2.7
4	Seek solutions to high staff turnover and vacant posts.	2.2, 3.2
Clarify the future vision of role of public-sector research and extension in relation to the private sector		
33	The public sector should gradually shift to regulating and facilitating seed production.	6.3
36	Review varietal release, plant breeding and seed-supply regulations.	6.3
Provide more funds for operational expenses		
5	Increase self-earning requirements and contract funding. Strengthen monitoring and change recruitment regulations.	2.6, 2.7
6	Increase funds for operations.	2.4, 2.7
8	Even out the flow of funds over the year.	2.4
11	Organise at least one-third of research resources on problem-area basis.	2.7
B. ORGANISATIONAL ISSUES		
Review research and extension infrastructure		
7	Review and rationalise research infrastructure.	2.3, 2.7
9	Revise criteria for prioritising AICRP funding, and re-organise AICRPs.	2.3
22	Limit ICAR funding of its own extension activities to 10% of budget.	4.3
23	Close or relocate under-performing KVKs and farm training centres. Rationalise the KVK/FTC system to minimise gaps and overlaps.	4.3
24	Slim down and reinvigorate AICRPs to generate technologies of interest to the states.	4.3
25	Tighten research organisation and management in the SAUs.	4.3

Increase the number and seniority of social scientists		
2	Increase social-science allocation to 5.0% of ICAR's budget and improve social science capabilities.	1.3, 2.7
Develop human resources more widely - especially broadening socio-economic awareness and participatory client-oriented skills		
15	Strengthen scientists' skills to promote client-orientation.	2.7
Update and broaden curricula for undergraduate/ postgraduate and in-service training		
16	Revise training curricula and provide in-service training in client-orientation.	2.7
17	Organise exchanges with private sector and NGOs.	2.7
20	Streamline and strengthen extension staff-training procedures.	3.4
C. METHODS AND APPROACHES		
Shift to more multi-disciplinary on-farm research strongly client-oriented, with strong feedback from farmers. Institutionalise these through appropriate institutional and fundinq mechanisms		
13	Strengthen stakeholder involvement in the approval of research projects and in their governance.	2.7
14	Make the implementation of research projects more participatory, monitor them more closely, and draw out lessons more fully.	2.7
19	Increase flexibility for extension workers to identify and respond to farmers' needs.	3.4
27	Co-ordinate technical options for micro-watersheds on a participatory and "system" basis. Provide implementing agencies with funds for contracting research.	5
28	Emphasise social-science research in micro-watersheds.	5
Capture and build on indigenous knowledge		
32	Incorporate farmers' drought-risk-avoidance practices into plant breeding and selection.	6.3
Promote participatory needs assessment and technology screening, testing, feedback and dissemination		
31	Conduct plant-breeding or varietal-selection trials on-farm rather than on-station. Revise criteria for varietal testing and release.	6.3

Promote alternative methods of extension delivery: NGOs, para-extension workers, mass media etc.		
18	Try out new approaches to extension such as mass media and farmer-to-farmer information exchange.	3.4
21	Introduce innovations in research-extension linkages, including multi-agency approaches to extension and the wider use of para-extension workers.	4.3
29	Establish a database on released varieties.	6.3
30	Relax procedures for varietal release. Consult the private sector and NGOs on how to improve release and certification procedures.	6.3
34	Test and promote new seed-supply methods.	6.3
35	Encourage and regulate truthful labelling.	6.3
Strengthen management information systems		
10	Improve research-information systems and telecommunications.	2.7
26	Improve bibliographic and project-management-system databases.	4.3

EXECUTIVE SUMMARY

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Recommendation 5: Increase the self-earning requirement of research institutes and universities, and raise the proportion of research conducted under contract funding. Establish appropriate monitoring systems, and change regulations governing recruitment so directors can engage contract staff, taking full advantage of these provisions.

=> Sections 2.6, 2.7

Some consolidation and rationalisation of research infrastructure is required to save costs and improve efficiency, particularly in the large number of regional or sub-stations operated by the ICAR centres and the SAUs. Cost savings in this area will contribute towards a further desirable goal: more adequate funding for the operational costs of research. The demand for operational funds will rise substantially if more research is to be done on farmers' fields.

Recommendation 6: In those parts of the ICAR and the SAUs concerned primarily with rainfed farming, raise the funds available for operational expenses to at least 30% of overall expenditure.

=> Sections 2.4, 2.7

Recommendation 7: The ICAR and the governments of the principal rainfed-farming states should jointly review research infrastructure with a view to rationalising it.

=> Sections 2.3, 2.7

Recommendation 8: Even out the flow of funds to research institutes over the financial year, so that a steady flow of research can be conducted.

=> Section 2.4

Enhancing the complementarity between ICAR and SAU research. Only limited gains in complementarity can be expected from formal provisions and over-arching plans. However, gains can be expected from stronger research-information systems. For instance, requiring scientists to use such information systems to demonstrate that their proposals take account of other research would reduce overlaps at the project and programme level. Improved research-information systems and wider access to email will help to breakdown current widespread isolation in ICAR institutes and SAUs. Movement in this direction depends largely on changes in incentive and reward systems and on the quality of research management.

Recommendation 9: Implement as soon as possible the AICRP-Review Committee's criteria for prioritising areas for funding, and its suggestions on the continuation and organisation of AICRPs.

=> Section 2.3

Recommendation 10: Make research-information systems and telecommunications (especially email) more fully operational and reliable, among even the more remote research stations.

=> Section 2.7

Allow problem-area focus to influence the structuring of programmes within institutes. A research institute organised entirely on a discipline or commodity basis lends itself to research that derives largely from the scientists' own preferences. By contrast, one organised largely on the basis of carefully prioritised problem areas encourages disciplines to be drawn into addressing clients' problems.

Recommendation 11: Organise at least one-third of research resources on a problem-area basis.

=> Section 2.7

Strengthen project-cycle management. Major opportunities exist for strengthening the research project cycle. At the preparation stage, clients need to be identified more clearly, and a careful needs diagnosis conducted. Researchers should be able to use a computerised database to locate their own proposals in relation to other studies. Proposals should indicate the anticipated economic and social impacts of the

proposed research. The proforma for proposals should be modified to accommodate these items.

Recommendation 12: Strengthen the management of the research-project cycle to make it more client-oriented and to make the relationship between activities, outputs and purpose more transparent. Introduce a logical framework (logframe) approach to planning and management.

=> Section 2. 7

Procedures for the approval of research projects need to be strengthened. In most cases, ICAR scientific research committees consist only of the full complement of research staff. This has three negative consequences: (i) it is difficult to reject proposals in this forum (since the authors of the rejected proposals would lose face); (ii) disciplines such as the social sciences are currently under-represented on the committees; and (iii) clients are poorly represented. As research becomes more client- and problem-focused, client representatives (eg, the commercial sector, NGOs, farmers' groups) should become more heavily involved in governing it. This implies a stronger hand in commissioning and monitoring research, and evaluating both research projects and the performance of individual scientists.

Recommendation 13: Strengthen stakeholder; involvement in the approval of research projects and in their governance.

=> Section 2.7

The implementation of projects can be greatly strengthened. There must be continuing consultation with clients as the research progresses. For many types of research, experiments should be conducted on farmers' fields and with the strong participation of farmers. The progress of projects-especially the longer ones- against objectives should be monitored carefully.

At the review stage, lessons for further work need to be drawn out, and feedback from clients should be encouraged and acted upon.

Recommendation 14: Make the implementation of research projects more participatory, monitor them more closely, and draw out lessons more fully.

=> Section 2.7

Develop human resources. The changes outlined above require scientists to master new skills. These include:

- Needs-assessment techniques, including the role of such techniques as participatory rural appraisal.
- The preparation of research proposals, including logframe formats if, as recommended, these are adopted by the ICAR.
- Management of the research-project cycle, from preparation through implementation to review, including the conduct of participatory, on-farm research and the eliciting of feedback from farmers.
- Understanding of farmers' risk-averting practices and their implications for the design of research and the formulation of recommendations.
- Improved understanding of current neo-liberal concepts on the roles of government, commercial and non-profit organisations in technology generation and dissemination for low-resource farmers.
- The preparation and management of research and service contracts with commercial organisations and NGOs; the management of patenting, licensing and royalty arrangements.
- Modes of working in multi-organisation partnership with research and extension agencies within and outside the public sector.

Recommendation 15: Strengthen scientists' skills in a number of areas to promote client-orientation: needs-assessment, proposal preparation, project-cycle management, indigenous knowledge, the roles of government, non-government and private sectors, contracts and patenting, and working in partnerships.

=> Section 2.7

Recommendation 16: Revise the curricula used by education and training institutions to ensure high standards of training in these areas. Provide in-service training for current scientists. Ensure that the faculty of the organisations concerned are up-to-date with the issues and have adequate training materials.

=> Section 2.7

Recommendation 17: Organise programmes to exchange scientists between ICAR institutes and commercial organisations and the larger technology-oriented NGOs.

=> Section 2.7

3. Strengthening the Organisation and Management of Extension

The recent growth in radio, television and video in many villages, and advances in farmer-to-farmer extension approaches, offer opportunities for new approaches to extension.

Recommendation 18. Try out new approaches to extension which rely less on face-to-face contact between 'extension agents and farmers, and more on innovative vehicles (such as mass media) and on support of farmer-to-farmer information exchange.

=> Section 3.4

Much of the extension service is currently driven by targets and restricted to the varieties of crops that have been officially released.

Recommendation 19: Increase flexibility so that extension workers can focus more on identifying farmers' requirements and responding to them.

=> Section 3.4

Training is currently conducted in three different types of organisation (the SAUs, the KVKs and the departments of agriculture), leading to gaps and overlaps. The curricula of training courses should be modified to cover the complexity and diversity of rainfed farming, needs-assessment methods, the conduct of on-farm trials, the assessment of risk, the understanding of risk-averting techniques, working in multi-organisational partnership in research and extension, group formation, the development of leadership skills, conflict resolution, etc.

Recommendation 20: Set up a joint committee at the state and district levels with representations from SAUs, KVKs and Department of Agriculture to streamline and strengthen extension staff-training procedures.

=> Section 3.4

4. Strengthening Research-Extension Linkages

Implementation of the above recommendations for strengthening rainfed research (=> Section 2) and extension (=> Section 3) will strengthen the client-orientation of both, create space for demand to drive the agenda, and so stimulate both existing and new linkages between research and extension.

The public sector faces chronic problems in the provision of extension services to many rainfed areas, given the rapid turnover of extension staff and the high proportion of vacant posts at any one time. Recognising this generates scope for reform.

Recommendation 21: Introduce more widely innovations in research-extension linkages, including multi-agency approaches to extension and the wider use of para-extension workers.

=> Section 4.3

Responsibility for much agricultural research lies with the centre, whereas extension is principally a state subject. The state-centre divide thus cuts squarely across research-extension linkages. ICAR understandably seeks to show that its technologies are working in the field. Its funding for extension activities under its own control (including the KVKs and IVLP) has increased over 12% of its budget. In view of the states' major responsibility for extension, and the need for a limit to the funding ICAR devotes to extension, alternative funding for the KVKs should be sought. Some KVKs do not perform adequately, and there are overlaps and gaps between the KVKs and farmer training centres. The current system of All India Co-ordinated Research Projects needs streamlining, and research by ICAR and the state agricultural universities should take previous and current research elsewhere into account. These changes will increase demand on the research-information system.

Recommendation 22: Limit ICAR funding of its own extension activities to 10% of the ICAR Plan budget.

=> Section 4.3

Recommendation 23: Together with relevant state governments, review KVKs and farm training centres individually against their mandates. Close or relocate those performing poorly. Rationalise the KVK/FTC system to minimise gaps and overlaps.

=> Section 4.3

Recommendation 24: Slim down and reinvigorate AICRPs to generate technologies of interest to the states, which they can then adopt and utilise into their own extension services.

=> Section 4.3

Recommendation 25: Tighten organisation and management in the SAUs. All research proposals should take account of other recently completed or on-going research, including that of the ICAR institutes, to increase the prospects of one drawing upon the other.

=> Section 4.3

Recommendation 26: Make the bibliographic and project-management-system databases more comprehensive and reliable, and train researchers how to use them.

=> Section 4.3

5. Enhancing Technology Support for Rehabilitated Micro-Watersheds

Micro-watershed rehabilitation is a specific feature of rainfed areas, and offers scope for enhanced productivity of crops and livestock, requiring varieties and management practices unfamiliar to farmers. This offers particular scope for new technologies provided through research and extension services. To do this efficiently, several preconditions need to be in place.

Recommendation 27: Co-ordinate technical options for micro-watersheds on a participatory and "system" basis. Funds for contracting research must be in the hands of agencies implementing micro-watershed rehabilitation; they must be able to ensure that research and extension are conducted in a problem-focused and participatory way.

=> Section 5

Recommendation 28: Research and extension services should draw on social-science skills in the micro-watershed context, to understand -farmers' risk-avoiding practices, institutional issues relating to sustainability, and how to combine enhanced productivity with distributional equity.

=> Section 5

6. Enhancing the Spread of Technology Embodied in Input Supply: The Example of Seed

The opportunities in this area are many, of great economic potential, and ripe for exploitation. Several opportunities suggest themselves:

Recommendation 29: Establish a comprehensive and regularly updated database of the characteristics (and sources of seed) of released varieties.

=> Section 6.3

Recommendation 30: Relax procedures for varietal release in individual states (by the public, commercial and voluntary sectors) to allow easier and quicker release of materials bred for similar agro-ecological conditions in other states. Consult the private sector and NGOs on how to improve release and certification procedures.

=> Section 6.3

Recommendation 31: Conduct plant-breeding or varietal-selection trials on-farm rather than on-station. This will close the gap between what breeders produce and what farmers want. Develop a set of criteria for testing and release which includes such indicators as fodder value, cooking and processing quality of grain, and so reflect more closely farmers' own criteria.

=> Section 6.3

Recommendation 32: Study farmers' practices to avoid the risk of drought in semi-arid areas. Incorporate these into breeding and selection procedures.

=> Section 6.3

Recommendation 33: The public sector should continue as a provider of seed where private markets are poorly developed, but its role should gradually shift to that of regulator and facilitator of productive activity.

=> Section 6.3

Recommendation 34: Test and promote a wide range of seed-supply options in semi-arid areas, including those involving the NGOs and farmers' groups.

=> Section 6.3

Recommendation 35: Facilitate, regulate and monitor wider use of truthful labelling.

=> Section 6.3

Recommendation 36: Thoroughly review the regulatory framework for possible improvements in varietal release, plant breeding and seed-supply systems.

=> Section 6.3

7. Nature of Issues

Our recommendations can be divided roughly into three general types of issues: generic (affecting the research and extension system as a whole), organisational (relating to the internal organisation of the research and extension systems), and methods and approaches (concerning the methods used in research and extension). Each of these categories can be further subdivided. Table 1 summarises our recommendations according to these three categories.

Table 1 :
Summary of recommendations by type of issue

Recommendation No.		**=> Section**
A. GENERIC ISSUES		
Strengthen problem focus of research design and devise mechanisms for improving the project management cycle		
1	Implement previous recommendations.	1.1, 8
2	Make project-cycle management more client-oriented and transparent.	2.7
Resolve chronic problems in reward systems, merit promotion, transfer, staffing, etc		
3	Introduce merit-based promotion, and redefine staff-appraisal and performance criteria to reflect client-orientation.	2.5, 2.7
4	Seek solutions to high staff turnover and vacant posts.	2.2, 3.2
Clarify the future vision of role of public-sector research and extension in relation to the private sector		
33	The public sector should gradually shift to regulating and facilitating seed production.	6.3
36	Review varietal release, plant breeding and seed-supply regulations.	6.3
Provide more funds for operational expenses		
5	Increase self-earning requirements and contract funding. Strengthen monitoring and change recruitment regulations.	2.6, 2.7
6	Increase funds for operations.	2.4, 2.7

8	Even out the flow of funds over the year.	2.4
11	Organise at least one-third of research resources on problem-area basis.	2.7
B. ORGANISATIONAL ISSUES		
Review research and extension infrastructure		
7	Review and rationalise research infrastructure.	2.3, 2.7
9	Revise criteria for prioritising AICRP funding, and re-organise AICRPs.	2.3
22	Limit ICAR funding of its own extension activities to 10% of budget.	4.3
23	Close or relocate under-performing KVKs and farm training centres. Rationalise the KVK/FTC system to minimise gaps and overlaps.	4.3
24	Slim down and reinvigorate AICRPs to generate technologies of interest to the states.	4.3
25	Tighten research organisation and management in the SAUs.	4.3
Increase the number and seniority of social scientists		
2	Increase social-science allocation to 5.0% of ICAR's budget and improve social science capabilities.	1.3, 2.7
Develop human resources more widely - especially broadening socio-economic awareness and participatory client-oriented skills		
15	Strengthen scientists' skills to promote client-orientation.	2.7
Update and broaden curricula for undergraduate/ postgraduate and in-service training		
16	Revise training curricula and provide in-service training in client-orientation.	2.7
17	Organise exchanges with private sector and NGOs.	2.7
20	Streamline and strengthen extension staff-training procedures.	3.4
C. METHODS AND APPROACHES		
Shift to more multi-disciplinary on-farm research strongly client-oriented, with strong feedback from farmers. Institutionalise these through appropriate institutional and fundinq mechanisms		
13	Strengthen stakeholder involvement in the approval of research projects and in their governance.	2.7
14	Make the implementation of research projects more participatory, monitor them more closely, and draw out lessons more fully.	2.7
19	Increase flexibility for extension workers to identify and respond to farmers' needs.	3.4
27	Co-ordinate technical options for micro-watersheds on a participatory and "system" basis. Provide implementing agencies with funds for contracting research.	5
28	Emphasise social-science research in micro-watersheds.	5
Capture and build on indigenous knowledge		
32	Incorporate farmers' drought-risk-avoidance practices into plant breeding and selection.	6.3

Promote participatory needs assessment and technology screening, testing, feedback and dissemination		
31	Conduct plant-breeding or varietal-selection trials on-farm rather than on-station. Revise criteria for varietal testing and release.	6.3
Promote alternative methods of extension delivery: NGOs, para-extension workers, mass media etc.		
18	Try out new approaches to extension such as mass media and farmer-to-farmer information exchange.	3.4
21	Introduce innovations in research-extension linkages, including multi-agency approaches to extension and the wider use of para-extension workers.	4.3
29	Establish a database on released varieties.	6.3
30	Relax procedures for varietal release. Consult the private sector and NGOs on how to improve release and certification procedures.	6.3
34	Test and promote new seed-supply methods.	6.3
35	Encourage and regulate truthful labelling.	6.3
Strengthen management information systems		
10	Improve research-information systems and telecommunications.	2.7
26	Improve bibliographic and project-management-system databases.	4.3

1. INTRODUCTION

1.1 General Perspectives

There is no shortage of high-quality perceptions, recommendations and guidelines both at central and at state government levels on how to organise Indian research and (to a lesser degree) extension to make them more relevant to the clients' needs. Reviewers who have recently made strong contributions in this regard include the Johl Committee (ICAR 1995b) and the G. V. K. Rao Committee (ICAR, 1988). The ICAR has also commissioned the TATA Consultancy report on organisation and management of ICAR headquarters, the K. V. Raman Committee report on administration and ministerial services in ICAR, and the S. P. Rai report on personnel policies. Within the ICAR, procedures are now in hand to introduce many of the recommendations emanating from these reports.

The central difficulty, as we argue in this paper, lies in the highly uneven implementation of sound ideas. Our search throughout is therefore for simple, robust and effective means of overcoming the barriers to implementation (=> Section 7 for some suggestions on these). We have concluded that there is major scope for improving the organisation and management of technology provision for rainfed farming, and that stronger social-science skills are a foundation of such improvements. However, organisational change and new skills will have little impact unless accompanied by change in four underlying dimensions:

- incentives for individual professionals;
- an increase in the proportion of operational funds available;
- facilities, especially the availability of information; and
- institutionalised learning across several spheres.

Change in these underlying factors is difficult, yet there can be little sustainable improvement in the provision of technology for rainfed farming without it.

1.2 What Makes Rainfed Areas Different?

Irrigated areas producing the major cereals (rice and wheat) have long served as a breadbasket to India's burgeoning urban population. This role was greatly reinforced by the Green Revolution, when fertiliser-responsive, short-straw varieties were taken up rapidly.

There have been occasional instances of rapid technology-based growth in crop production in the more reliably rainfed areas, such as in oilseeds, but for reasons outlined below, we do not see the "mission mode" approach underlying these as a universal panacea.

On the whole, conditions between irrigated and much of the rainfed land differ substantially, and it would be naive to suppose that a second Green Revolution might occur in rainfed areas. Such differences are detailed in Section 2. Briefly, the rainfed areas are disadvantaged in a number of ways:

- Widely diverse and, in some cases, environmentally fragile agro-ecological conditions, with irregular rainfall and nutrient-poor soils, contribute to the need for risk-averse approaches to farming.
- The farming population has limited capacity to articulate their needs, unless supported by participatory approaches. :
- A wide diversity of varieties, cropping patterns and farming l practices makes it difficult for research to respond specifically to these.
- Weak infrastructure makes it difficult to engage the private sector with all but high-value, easily transported products.

The above conditions have two broad implications for research:

1. It is difficult to replicate farmers' conditions on-station, so that farmers' opinions and knowledge have to be drawn upon in two ways: by having them visit research stations and give their opinions at an early stage on the technologies being tested; and by conducting more adaptive testing under farmers' conditions (for which the necessary resources have to be made available and skills acquired).
2. Farmers cannot be assumed to be motivated by profit maximisation alone: much stronger effort is needed than in irrigated areas to understand the influence on their farming practices of risk-aversion, and of other socio-economic and cultural factors, including the role of women (especially in areas of high seasonal migration).

1.3 The Need for Social-Science Skills

Farming conditions in many parts of the rainfed areas are complex, diverse and risk-prone. The need for social-science inputs into the research process, and into related organisational and institutional change, is determined fundamentally by the fact that these conditions cannot easily be replicated on-station and subjected to reductionist observation. Compared with irrigated areas, a greater part of the effort towards technical change must be made on-farm, under existing farming and natural resource-management systems, and in the context of prevailing socio-economic and behavioural modes and conventions. Rainfed areas differ fundamentally from irrigated areas in this respect, and in the amount of risk involved in agricultural production. On-station experiments typically eliminate or minimise risk, so for rainfed areas may result in recommendations for input levels and practices which farmers find unacceptable. Social-science skills are essential to understand farmers' risk-averting practices and to design technology appropriately for them.

However, social-science skills are valuable not only because they may lead to technologies that yield productivity gains. They may also contribute to technological changes with acceptable levels of distributional equity (so that the weaker groups are not further marginalised), and to the sustainability, both institutional and environmental, of those changes. Sustainability and equity are, of course, concerns relevant also to irrigated areas, but we argue below, especially for instance, in the rehabilitation of micro-watersheds (=> Section 5), that they have unique characteristics in rainfed areas.

The CGIAR has recognised the contribution of social sciences to improved technology design through a combination of inputs at project, policy and institutional levels. A recent report (CGIAR Panel, 1996) notes that policy and management research and socio-economic research account for some 15% of the CGIAR budget and 18% of its personnel, and recommends further increases. Within the ICAR, in contrast, sanctioned positions in social sciences (economics and extension), policy and management sciences account for only 7.5% of the total scientific positions.

1.4 Research, Extension and Technological Change

The findings of research reach farmers in the form of improved technologies. These may be either hardware (such as improved seed or equipment) or software (such as improved management practices). The introduction of improved technology by farmers is called "innovation". However, this is not a simple process. Successful innovation depends on:

- the appropriateness of the technology to farmers' conditions;
- the availability of appropriate information and inputs through which the technology is conveyed; and
- favourable supporting conditions, such as credit, market, and so on.

The more the farmers innovate, the more effective research and extension have been. In Section 6, improved seed for rainfed areas is discussed in depth as an example of how farmers' capacity for ; innovation can be promoted. This necessitates improvements in

procedures for varietal testing and release, improved mechanisms for seed delivery, and client-orientation in deciding on plant breeding priorities.

At several points in the paper, we argue that attempts to improve the effectiveness of public-sector research and extension have focused too strongly on components of research or extension, and have lost sight of what needs to be done to put in place the preconditions for innovation. There have been rare exceptions to this narrowness of approach in respect of rainfed farming, such as the Oilseeds Production Mission. We recognise the success of this mission-mode approach, but feel unable to recommend it as a general practice for two main reasons:

- The co-ordinated attention it demands of researchers, extension personnel, the rural banking system and policy makers is unlikely to be sustained over more than a very few crops for the necessary 5-10 year period.
- The commodity focus of the approach distracts attention from chronic constraints attributable to a fragile and diminishing resource base.

Efforts to improve the resource base are channelled especially through the rehabilitation of micro-watersheds. Such rehabilitation reduces soil and water runoff, improves percolation, increases the availability of fodder and water for irrigation, and so results in the introduction of new crops and varieties. Farmers are unlikely to be familiar with technologies that .will enable them to take full advantage of these possibilities. Research and extension services can play a major role in providing these from outside. The uptake of farm-level technology could also be better enhanced through improved provision of the genetic resources used by farmers.

1.5 Aims and Organisation of this Paper

There is no "magic bullet" to resolve the problems and address the opportunities facing research and extension for rainfed farming. The issues are complex, many of them have been raised repeatedly over several decades, and progress towards meeting them has been uneven. Some have attributed the problem largely to poor research-extension linkages. However, in our view, the type and quality of linkages depend fundamentally on the qualities of research and extension themselves. Put bluntly, no matter how good linkages are, they will be to no avail if the proposed technologies are inappropriate to clients' needs. By contrast, a healthy and responsive research system producing what farmers need, helps to create interest and job-satisfaction on the part of extension services, and so sets the scene for strong linkages.

We begin this paper with an overview of the issues facing research for rainfed farming (=> Section 2), followed by a review of those facing extension (=> Section 3). We then draw out the issues relating to research-extension linkages (=> Section 4).

We follow this with two short sections highlighting opportunities that offer much potential for strengthening the effectiveness of research and extension systems for rainfed farming. These are technology responses to watershed rehabilitation (=> Section 5) and enhancing the spread of technology embedded in input supply, taking seed as an example (=> Section 6). We conclude with a section on modes for implementing these strategies (=> Section 7).

Information presented in this paper is drawn from a wide range of interviews:

- With the directors and senior staff of a number of ICAR institutes, directorates and projects. These were conducted primarily during field visits in October 1996, but in some cases also through longer-term contact (CSWCR&TI, CRIDA, CAZRI, NDRI, NAARM, MANAGE, CSSRI, Project Directorate for Cropping Systems Research, Directorate for Oilseeds Research, National Seeds Project, and the KVKs based at three NGOs- Youth for Action (Mehboobnagar, Andhra Pradesh), the Vidya Bhawan Society (Udaipur, Rajasthan) and the Agricultural Development Trust (Pune, Maharashtra)).

- With the vice-chancellor and senior staff of Acharya N G Ranga Agricultural University in October 1996; the director of the Zonal Research Station at Palem (Andhra Pradesh) and with staff of Rajasthan Agricultural University over a period of time.
- With directors of State Department of Agriculture (Andhra Pradesh and Rajasthan), and the Additional Director of Agriculture (Extension), State Department of Agriculture of Maharashtra, and with the director of the Andhra Pradesh State Seeds Corporation.

The authors are indebted to all of these. We also drew on a range of reports concerning aspects of the research and extension system. These are listed in the References section.

2. ORGANISATION AND MANAGEMENT ISSUES IN RESEARCH

2.1 Origin and Structure

The apex organisation for agricultural research in India, the Indian Council of Agricultural Research, currently provides core funding to 45 Central Research Institutes, 30 National Research Centres, four National Bureaux, 10 Project Directorates, and their 165 regional stations. The ICAR also funds 86 All-India Co-ordinated Research Projects, which have some 1100 co-operating centres, and a further 16 other projects or programmes. The ICAR also promotes research, education and extension through 28 State Agricultural Universities and one Central University by providing financial assistance in various forms. The ICAR also maintains a network of 261 Krishi Vigyan Kendras and eight Trainers-Training Centres along with eight Zonal Co-ordinating Units. The major research activities of the ICAR and SAU units are elaborated in Table 2.

Table 2:
Major research activities of ICAR and SAUs

Component	No.	Main activities
ICAR		
National Research Institutes	4	Basic and strategic research of national importance, education, manpower training
Central Research Institutes	41	Commodity- or resource-specific basic and strategic research, with divisional setup, education
National Bureaux	4	Conservation and exchange of germplasm and natural resources
Project Directorates	10	To fill critical research gaps in All-India Co-ordinated Research Projects, research co-ordination
National Research Centres	30	Commodity-, resource- or discipline-based strategic research in mission mode
All India Co-ordinated Research Projects	86	Co-ordination of commodity- or resource-specific research in different zones
Agricultural Universities		
Central Agricultural University	1	Region-specific applied research and education
SAUs	28	Applied research for the state, education
Zonal Research Stations	120	Adaptive research for the zone

Source: ICAR (1997 a) and Ghosh (1991)

Through these programmes and projects, ICAR also provides approximately 18% of the research funds available to the State Agricultural Universities, and a disproportionately high level of operating expenses for research, given that the much of the SAUs' revenue from the states goes into salary payments. It is impossible to give precise statistics on the proportion of

ICAR's budget that is allocated to research for rainfed farming: several of the institutes and programmes focus exclusively on rainfed farming (eg, CRIDA, CAZRI, CSWCR&TI), but so also do substantial parts of the mandate of other institutes (eg, IGFRI, CSSRI, NDRI). However, informal estimates suggest that around 30% of ICAR's resources are devoted to rainfed farming.

With financial support principally from the Rockefeller Foundation and USAID, the research services were organised to emulate the strengths of the US Land Grant model as it operated in the two decades before the Second World War. This entailed a strong local and practical focus by the state-level agricultural universities in both training and research; strong interaction between the state and federal levels, in which the states feed into and benefit from the more generic types of research conducted by organisations of central government; strong links between research and extension, including feedback to research of farmers' requirements; and a dominant ethos of client-orientation across the entire system.

Although the US model was worthy of emulation, it is clear that two key contextual features that contributed to the success of the US Land Grant system remained largely absent from India. These are: strong, articulate farmers' organisations capable of making demands on the research system, and a clear role for the private, commercial sector in marketing inputs which incorporate new technology, such as seeds and agro-chemicals. (Although their role in mechanical technologies has been stronger.) Its implications are considered below.

Numerous reports testify to the substantial successes of the research system for irrigated areas. The characteristics of these greatly facilitate the design and introduction of new technology, namely:

- homogeneous agro-ecological conditions, easily replicated on research stations;
- articulate, commercially oriented farmers, operating under conditions of minimal risk and prepared to visit research stations and convey their needs to researchers, give feedback on technologies already tried, and so on;
- large, homogeneous markets, allowing easy and profitable penetration by the private, commercial sector in marketing inputs and outputs; and
- good physical infrastructure, allowing low-cost communications and transactions.

2.2 What Makes Rainfed Areas Different, and How Successful has Research been

Approximately 68% of India's net cultivated land is currently rainfed. It supports some 360 million people, rising to perhaps 600 million by 2020. Even after the realisation of India's full irrigation potential by 2013, it is estimated that around 50% of India's total cultivable area of 142 million ha will remain rainfed. By 2020 this may need to support some 600 million people. Clearly, science will have to generate-and extension services will have a key role in disseminating-the productivity-enhancing technologies that will be necessary to improve the livelihood of this burgeoning population.

The conditions outlined above which facilitated rapid technical change, in high-potential irrigated areas, are largely absent from rainfed areas:

- Rainfed agro-ecological conditions are widely diverse, even within small areas; irregular rainfall makes conditions risk-prone in many areas; and nutrient-poor soils provide a weak basis for conventional agricultural intensification. The environmental and institutional sustainability of technical change are of special concern, as is distributional equity, especially in areas where weaker sectors have only limited access to natural resources.
- Farming populations have long been outside the political and economic mainstream. Levels of self-confidence and of formal education are low, making it difficult for farmers to articulate their technology needs.

- The diversity of varieties, cropping patterns and farming practices in use means that markets for any individual input are small and fragmented. This, together with poor transport and communications infrastructure, acts as a powerful disincentive for the private, commercial sector to become involved in input supply.
- Difficult living conditions in many rainfed areas make public-sector staff reluctant to stay in post there, resulting in exceptionally high turnover of staff and a high proportion of vacant posts.

Farmers' responses to these conditions include a number of risk-avoiding practices. They avoid using high levels of purchased inputs in case crop failure (through, for example, drought) leads to major financial losses. They rely on well-tried early-maturing varieties that meet both their grain and fodder needs. They crop in mixtures or relays. They rely heavily on the use of biomass from off-farm sources (such as grazing and forest areas). They integrate crop and livestock production closely.

There is no comprehensive review detailing the proportion of technologies generated by rainfed-farming research that have been taken up, or comparing this with irrigated areas. However, there is substantial, informal evidence of low uptake at some stations we visited. Hard data are available in one specific area: the replacement by the research and extension system of existing crop varieties by new ones. A well-functioning research service is aware of the types of crop varieties preferred by farmers in different agro-ecological zones, and will use these as a basis for breeding new varieties. If researchers are able to target farmers' requirements accurately, then existing varieties will be replaced with new ones every few years, and the average age of varieties grown in any one season, weighted by area planted, is low. In highly efficient agricultural systems, the average age is only a few years. Thus, in the UK, wheat-breeding services produce adoptable new varieties with such frequency that the average age of cultivars in use is only approximately three years. Given the more difficult conditions in India, the average age of cultivars might be expected to be somewhat higher, say, 8-10 years. However, Table 3 shows that the average age of cultivars of typically rainfed crops (with the exception of pearl millet) is high, and is much higher than that for usually irrigated crops (rice and wheat).

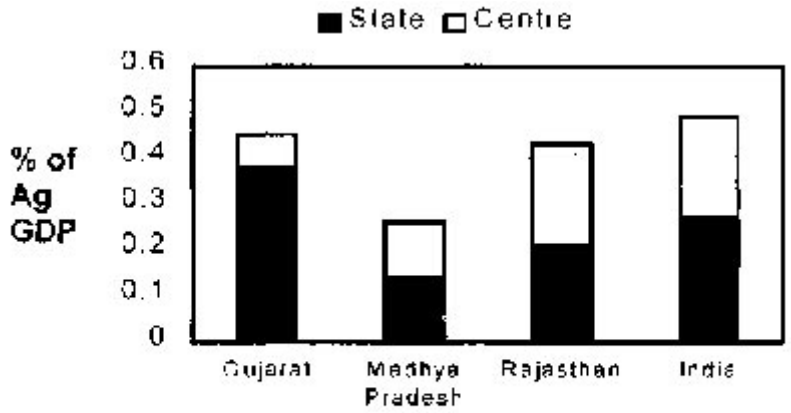
Table 3 :
Weighted average age (years) of cultivars of important crops

Region	Gujarat	Madhya Pradesh	Rajasthan	All India
Normally irrigated				
Rice	17.1	13.3	12.5	11.5
Wheat	12.3	11.4	10.7	9.3
Normally rainfed				
Pearl millet	5.8	-	8.4	5.8
Maize	19.8	26.7	11.4	16.6
Sorghum	7.8	17.3	-	15.9
Groundnut	9.1	-	12.9	15.3
Chickpea	19.7	26.3	11.8	12.9

Source : Witcombe et al. (1998).

This suggests a lower performance by the research system in introducing new varieties to replace existing ones in rainfed than that in irrigated areas. This may partly be because of failure on the part of the researchers in targeting farmers' requirements accurately, and also because of the lower research intensity in rainfed states (Figure 1).

Figure 1: Research and education expenditure as percentage of agriculture gross domestic product (1992-94 average)



Source . Pal and Singh (1997)

An ICAR report (ICAR, 1995a) suggests that the continuing low uptake of new technologies in complex, diverse and risk-prone rainfed areas is attributable, among other things, to:

- Insufficient study of the farming situations, and inadequate perception of farmers' circumstances and their needs by scientists.
- Widely differing conditions on the research stations (where research is conducted) as compared to farmers' fields (where technology is adopted).
- Excessive discipline-orientation instead of problem-orientation of the scientists.
- Inadequate farmers' participation in formulation of research and transfer-of-technology agenda.
- Recommending technology based on the results at the research station without adequate and proper testing in the farmers' fields under the farmers' resource and risk situations.
- Lack of appreciation to distinguish science from technology.

Two notes of caution should be sounded in relation to current enthusiasm for conducting a higher proportion of research on-farm:

1. We should not overlook the fact that science has an important role to play in broadening the range of options available to farmers, and that certain on-station work at the strategic or applied levels of research remains essential. For instance, some initial screening of lines available to plant breeders is more efficiently done on-station than on-farm. What is important, however, is that the criteria used for selection should reflect farmers' own conditions and preferences. In all cases, the important requirement is that the interface between what farmers require and what science offers has to be managed well.
2. The term "farmer participatory research" has come to mean very different things to different types of organisation. Many NGOs, for instance, pursue intensive, long-term types of participation which aim to empower farmers to recognise the conditions underlying their poverty, draw on their own resources as far as possible to improve these conditions, and draw in external resources (eg, from the state) where necessary. NGOs' freedom to mandate themselves to work intensively in a few

villages makes these empowering types of participation feasible. By contrast, public-sector services such as research and extension have to be spread much more thinly over a wide area. The concern within the public sector is therefore largely with functional types of participation which do not directly take on the major task of empowerment, but aim for the more modest goal of making public-sector services more relevant to farmers' needs.

Elaborating this theme, Figure 2 sets out the types of participation which have worked in relation to the biophysical and socio-economic conditions facing farms over the range of income levels. Income is a crude indicator, yet it is clear that, even within rainfed areas, higher-income farmers tend to rely less on common-pool resources for the livelihood, and so can operate on a largely individualistic basis. Functional forms of participation work well under these conditions. By contrast, the lower self-confidence of poor households and their heavier reliance on common-pool resources place a premium on group action, and on the skills necessary to elicit what types of technical changes are consistent with their needs.

There is still scope for functional types of participation in these contexts-for instance, in the introduction of new crop varieties. However, numerous technical challenges, especially those concerned with natural resource management, can only be addressed if more empowering forms of participation based on group action are undertaken. In such cases, there is substantial scope for research and extension services to link with the types of organisation, such as NGOs, which claim a comparative advantage in these areas.

Three major implications for research arise from these conditions:

1. Research conducted on-station is unlikely to reflect the agro-ecological and socio-economic factors faced by farmers. It therefore tends to generate recommendations for varieties which farmers find inappropriate, and for levels of purchased inputs which farmers find too high and too risky. A high proportion of experimentation for these areas therefore should be conducted on-farm and with farmer involvement.
2. Researchers need the skills to engage with farmers and elicit their needs, and they need to engage with other organisations (farmers' associations or NGOs) capable of interpreting and expressing farmers' needs.
3. There are powerful arguments-relating both to research and extension-for organising farmers into groups to deal with:

- the introduction of certain technologies (eg, integrated pest management);
- the introduction of new practices for the management of common-pool resources (eg, soil and water, grazing land);
- interactions with the market (especially the purchase of inputs such as seed which contain new technology); and
- the articulation of technology needs and the acquisition of technical advice from research and extension services or other sources.

Figure 2: Characteristics of successful participatory approaches across the range of farm income levels

Farm household income	**Highest income**	**Lowest income**
Biophysical characteristics	• Small no. of commodities • Highly intensive production • Few systems interactions	Large no. of useable products Strong systems interactions, ' esp. between on- and off-farm resources (trees, fodder)
Social & economic characteristics	• Individualistic, market-oriented production • Joint action may be important for eg, water management and input/output marketing	• Mainly subsistence-oriented • Joint action important for articulating demands, managing common-pool resources, • traditional practices (eg, exchange labour) • Reliance on part-time farming, seasonal migration, etc, in poorer households, and on "safety nets" in poorest
ective participatory approaches	• Public sector • Focused on improving technology delivery, akin to stronger client-orientation • Much assisted by farmers' (high self-confidence and ability to articulate needs	• NGOs • Small-scale, resource-intensive • Focusing on empowerment of farmers to understand range of options for meeting needs and t making demands on public sector • Joint action in common-resource management, input acquisition, etc.
Needs	Public sector to : • Set preconditions for efficient functioning of markets for a few inputs and advice • Regulate these as necessary • Withdraw to spheres (health, safety, environment) unlikely to be addressed by private sector	NGOs and public sector to : • Devise ways of using empowering approaches on wide scale, eg, through : NGO-government partnership; o Incentives to public-sector staff to work with low-income farmers in difficult areas. o Recognise importance of off-arm income sources, and of the limits to participation this may impose

The Johl Committee of ICAR also highlighted the need and scope for substantial farmer participation through farmers' associations in developing appropriate research programmes. These were necessary to take into account the complex knowledge, ecology and social environment of farmers (ICAR, 1995b).

2.3 Organisation of Research Services at the State Level

India has 28 SAUs operating from 65 campuses, and a further four ICAR institutes with "deemed university" status. Although initially conceived as single-campus institutions, the number of campuses per SAU now ranges between two and seven. Agro-ecologically specific "outreach" research is conducted by 120 Zonal Research Stations falling under the authority of the SAUs, and these in turn are supported by over 600 research centres and substations. The National Agricultural Research Project (NARP) initiated in 1978 strengthened research infrastructure in the Zonal Research Stations substantially.

The SAUs have state-wide responsibility for teaching, research and extension education. These were intended to integrate closely across all three functions and to embody an ethos of service to the rural community, through such actions as specialised training for rural youth outside conventional degree programmes. SAUs were expected to conduct primarily applied and adaptive research, leaving basic and strategic research to the ICAR system. In practice, the principal research link between the ICAR system and the SAUs has been via the All-India Co-ordinated Research Programmes. The SAUs have taken up responsibilities in relation to teaching, research and extension education to varying degrees, and the facilities established for training extension staff in particular have been poor. A recent review paper includes among the weaknesses of the SAUs (=> Box 1):

- continuing lack of location- and problem-specificity in research outputs;
- excessive fragmentation of research infrastructure, preventing critical mass in any one place;
- ineffective co-ordination among universities within a state, and among campuses within a university;
- establishment of degree programmes with extremely poor infrastructure and a large intake of students;
- excessive in-breeding: in several universities up to 90% of the academic staff obtained all their degrees in the university to which they were subsequently appointed;
- weak research-extension linkages;
- unclear definition of roles between SAUs and the line departments in extension education (NATP, 1995).

A study by MANAGE on farmer participation in research and extension revealed that the research programme-planning process of many ZRS was not relevant to the farmers' needs, nor have the researchers been able to embrace problem-solving adaptive research mode (MANAGE, 1993).

A review of the effectiveness of decentralisation in research funding and prioritisation (Jha and Kandaswamy, 1994) draws on evidence from Bihar and Tamil Nadu. It argues that if decentralised systems are working well, "researchers should be receiving feedback from farmers and extension agents about priority problems for new research and about the effectiveness of past research products, and there should be evidence of significant on-station and on-farm trials on local problems" (ibid, p. 2). In reality they find that research priorities are set centrally and in a top-down and mono-disciplinary fashion, and they reflect few of farmers' priority concerns. Further, there is little evidence of feedback to research via extension services; those with the most interaction with research tend to be senior extension staff, who in fact have least contact with farmers. The study also revealed the perception of researchers regarding the expected benefits from on-farm and on-station research (Table 4), calling greater attention for improvements in incentives and reward structure.

Box 1 : Problem besetting the SAD system : Rajasthan Agricultural University

The RAU is undertaking an ambitious programme of relocating its main campus to Bikaner, and plans to take the opportunity to introduce changes in organisation and management.

The appraisal report for the relocation indicated that, apart from construction and equipment, reforms were needed in the following areas :

- **Educational reforms :** a re-assessment of courses and quality standards in the light of changing market demand for graduates from the public to the private sector.
- **Research reforms :** an economics-based prioritization of the research programme, efforts to reduce overlap with other organizations, incentives to deans to promote multi-disciplinary research, and the closure of low-priority programmes and projects.
- **Institutional reforms :** including an end to in-breeding, higher standards for recruitment to the faculty, objective criteria for promotion (relying less on length of service and more on refereed - publications and uptake of research results by intended clients); improved communication and bibliographic links with other research institutes, nationally and internationally; a programme whereby 35% of the research budget would be earned from client commissions by 2000 and 50% by 2005;
- **Human-capital reforms :** including merit-based sabbatical leave; a post-doctoral exchange programme; and a number of new client-focused collaborative research programmes.

However, whilst almost Rs 300 million is envisaged for construction, equipment etc, under Rs 20 million is allocated for the other reforms outlined above.

Source : World Bank/Government of Rajasthan : Agricultural Development Project-Rajasthan : Agricultural Research and Training, Rajasthan Agricultural University.

Table 4 : Percentage of researchers indicating benefits from on-farm and on-station research

Expected benefit	Location	On-station research	On-farm research	Both
Career prospects	Aduthurai Zone	30	3	27
	Aruppukkottai zone	43	0	33
	RRI-Dholi	38	7	55
	ARI-Patna	21	5	74
Professional recognition	Aduthurai Zone	20	0	40
	Aruppukkottai zone	33	19	24
	RRI-Dholi	31	5	64
	ARI-Patna	21	5	74
Personal satisfaction	Aduthurai Zone	10	10	43
	Aruppukkottai zone	29	10	38
	RRI-Dholi	17	12	71
	ARI-Patna	26	11	63
Relevance of research	Aduthurai Zone	23	0	37
	Aruppukkottai zone	33	10	33
	RRI-Dholi	21	9	71
	ARI-Patna	16	16	68

Row totals do not add to 100 because several scientists did not respond to this question. Source: Jha and Kandaswamy (1994).

Case studies made while preparing the National Agricultural Technology Project on horticulture research in Maharashtra reached some persuasive conclusions. These included: a low standard of research priority-setting; the duplication of effort among universities, and between universities and other institutions and programmes (including those of ICAR) within the state; excessive SAU reliance on ICAR (especially AICRP) funding, resulting in distortions in research agenda; and lack of operational funds for research.

A nation-wide study on citrus research by a parallel team discovered that no fewer than 36 research units of different types were conducting research on citrus. This involved 45 scientists from ICAR and 41 in the SAUs-but only 22 ICAR and 11 SAU scientists did such research on a full-time basis. Of the 122 research activities being conducted, 93 were classified as "applied". There was hardly any "strategic" or "basic" research in the ICAR system, and hardly any "adaptive" in the SAUs. Apart from poor communications among researchers, the case study also indicated the absence of research-programme planning within the framework of national or state policy objectives, the rarity of cost-benefit analysis to assess potential impact and adoption, and the lack of reviews to assess the continuing relevance of on-going programmes.

The co-ordinated projects have become an important instrument of collaborative agricultural research in India's different agricultural institutions. There has been criticism of the AICRPs: some work currently under AICRPs could be conducted more effectively and cheaply at single locations than in a network context, there are substantial gaps in some of the AICRPs through significant on-station and on-farm trials on non-compliance of selected centres, and problems of non-comparability of data are common. An ICAR committee on AICRPs reviewed the relevance and continuance of all existing projects, and made recommendations for improving their structure and management (ICAR, 1997b).

2.4 Finance for Research

Current levels of finance for agricultural research and education have reached approximately 0.49% of agricultural GDP. But the share of agricultural research has lost ground from 20% of all research funded by central government in 1960-80, to under 12% by the late 1980s; major increases in allocations have gone to the Department of Science and Technology and to space research. In financial year 1993-94, some Rs 424 crores was spent on the ICAR headquarters and central institutes, and around Rs 526 crores on SAUs. Some 18% of SAU research expenditure came from the ICAR, but ICAR's contribution to agricultural education at the SAUs was halved between the Sixth and Eighth Plans. ICAR's expenditure on the KVKs increased fourfold over the same period, with the result that in the Eighth Plan, slightly more was allocated to the KVKs (12.3%) than that to agricultural education at the SAUs (11.9%). It has been argued that the shares of Plan expenditure on agricultural research and education among states bear no relation to their agricultural population, the number of farm holdings or even the total production of foodgrains in the various states (NATP, 1995).

Certainly, the northern region of India, which is dominated by irrigated production, consumes almost half of the total allocation, with approximately a quarter going to the southern region and the remaining quarter divided between eastern and western regions.

There are major concerns over the decreasing operational budgets for research at both ICAR institutes and SAUs:

"During the last 14 years, the share of establishment costs in the total expenditure increased from 26.33 to 59.22%. Non-recurring expenditure fluctuated within a narrow range of 16 to 19%. However, operational and maintenance expenditure decreased from 57 to 22%" (NATP, 1995).

The same source argues that the situation is considerably worse in many SAUs than in ICAR institutes.

Special funds, the largest of which is the Agricultural Produce Cess Fund, are seen by some of the institute directors interviewed as a means of increasing the amount of operational funds for research. Indeed, this source provided an additional Rs 8.6 crores of funds in 1993-94. Fund utilisation from the AP Cess Fund Scheme by scientists of ICAR and SAUs has been poor. This is due to long and uncertain delays in processing applications, tardy fund disbursements, inadequate control by the principal investigator on the funds he has brought through the scheme, and low motivation on the part of scientists to earn additional funds. The ICAR has recently issued fresh guidelines on the AP Cess Fund Scheme, addressing many of the above issues. Important among these is the decentralisation of financial powers to the principal investigator. However, the actual implementation of these new, liberal guidelines is uneven.

Several people in their interview mentioned that scientists bringing project funds into the universities face difficulty in drawing on those funds when they need to; in some cases, university finance officers transfer the funds into what are perceived to be other pressing requirements. To counteract this, it was recommended in the UP Diversified Agricultural Support Project that funds from the proposed agricultural research fund should be held in a separate bank account in the name of the project leader.

Several institute directors during interview noted that the problem lay not only in limited budgets, but also in the timing of their disbursement from the ICAR headquarters. For instance, in CSWCR&TI, between 55% and 65% of Plan and non-Plan funds for operational expenses were received in the final quarter of the financial year, making it difficult to maintain the necessary profile of research throughout the year.

To augment the financial resources of the institutes in a substantial manner, ICAR came up with a revolving fund of Rs 15 crores out of the AP Cess Fund, in which a one-time grant is given to ICAR institutions, SAUs and KVKs. The amount is recoverable from the fifth year onwards in equal instalments. This provision is presently of limited value for long-cycle activities such as horticulture or forestry. The financial rules governing the purchase of inputs and sale of produce also cause problems in implementing this scheme. The intention of revolving funds is mainly to generate resources or profit that should make repayment possible. The directors argued that these activities should be freed from the normal rules of purchase and sale.

2.5 Recent Changes in the Organisation and Management of Research

A number of changes have recently been, or are being, introduced to the research system (=> Box 2). These are of generic nature and not specifically geared to the needs of rainfed farming. However, these can be expected to have a positive influence on the performance of research for rainfed farming. These changes include:

- The provision for self-generation and retention of earnings by individual ICAR institutes. The level of these as a percentage of overall budgets varies from one institute to another. The implicit intentions underlying this provision are that institutes should become more strongly client-oriented; that staff reward-systems should be shifted to reflect their performance in meeting clients' needs, and that the availability of these funds should increase institute directors' flexibility to meet perceived needs.
- The provisions of the Johl Committee report (ICAR, 1995b) on partnership, resource generation, training, consultancy, contract research/contract service and incentive and reward systems. Basically, this report recommends closer partnerships between the ICAR and the private sector, and the introduction of certain practices characteristic of the private sector in applied and adaptive research, and in the provision of related services and training. It is envisaged that ICAR's products and processes will be much more widely patented than in the past, that royalties will be

obtained, and that charges will be made for advice, testing services and training. Whilst the ICAR will remain mandated to safeguard the interests of farmers, partnerships and practices of this kind will allow it to generate the resources necessary for modernisation.

- Modernisation, functional autonomy down to the individual scientist level, and performance-related reward systems within a merit-based system of promotion are regarded as essential for this purpose.
- The provisions of other commissioned papers concerning the restructuring of ICAR headquarters (TATA Consultancy report) and on staffing and remuneration (K. V. Raman report).

Box 2 : Recent and proposed reforms in ICAR

Over the last few years, the ICAR has been changing its policies to prepare for the future. It has also been making systematic efforts to implement several of the earlier recommendations. Most of the recommendations of the G.V.K. Rao Committee (ICAR, 1988) have been implemented. Given some reorganisation and decentralisation at the ICAR headquarters, the responsibility for taking all major decisions in management and research now rests with the heads of subject-matter divisions. For making policy decisions by joint consultation, the standing policy-planning committee has been revived and reconstituted. To strengthen linkages with related organisations like the Council for Scientific and Industrial Research and the Department of Science and Technology, joint panels have been created.

Delegation of powers. Several powers vested at the ICAR headquarters level have been delegated to institute director. In addition, a number of powers have been delegated recently to joint directors, head of regional stations, project co-ordinators, department heads and principal investigators of AP Cess Fund Projects.

Human Resource Development. Recent changes include the liberalisation of study-leave rules for both scientific and technical staff, the reorganisation of training programmes, the removal of service conditions of scientific and technical staff, the revamping of the award system, the introduction of new awards, an increase in prize money, and the introduction of a visiting-scientist scheme for engaging visiting Indian scientists or experts from within the country or from abroad in critical, well defined areas. Through the Agricultural Human Resource Development Project now being implemented, incentives such as in-service training, refresher courses and participation in conferences and seminars are being put in place.

Perspective Planing. All ICAR institutes have prepared perspective plans, with a visionary approach for the next 25 years. A perspective-planning and policy cell has been created at the ICAR headquarters.

Networking. During the Eighth Plan, ICAR began computerising its headquarters, research institutes and SAUs through a project called Agricultural Research Information System. This aims to link all the constituent units of the ICAR system.

Resource Generation and Partnership. ICAR accepted the recommendations of the Johl Committee, and has issued operational guidelines for individual and institutional consultancy, contract research and contract services. Increasing emphasis is now being given for resource generation. ICAR wants the institutes to commit themselves to resource generation of 10% to 30% in the Ninth Plan through consultancy, contract research, royalties, testing fee, training charges, etc.

The National Agricultural Technology Project has been formulated to bridge critical gaps in research and extension. The ICAR continues its organisational and management reforms by using financial support through NATP funds.

2.6 Shifting the Balance between "Core" and "Contract" Funding

In ways consistent with the thrust of the Johl Committee, a number of recent initiatives have sought either to supplement existing core funding for research by contract funds, or more radically, to replace part of the core funding with contract funds. Initiatives of this kind : are generally premised on the belief that research becomes more demand-driven, and hence more relevant to the needs of clients, when clients are able to "commission" research.

In a number of contexts, additional funds have been established to allow the "clients" of research and extension (usually farmers and ' the organisations representing or working with them) to contract research from the public sector or elsewhere on issues they find important but which are not currently addressed. These provisions include, for instance, the provisions for contract research made by the government of Rajasthan under the Agriculture Development Project. In such cases, the public-sector research institutions are expected to seize the opportunities offered, since such funds generally permit operational costs to be met adequately and so overcome what was identified above as a major current bottleneck in the public sector.

In a more radical case, the Diversified Agricultural Support Project under consideration by the government of Utter Pradesh is geared towards promoting- diversification and intensification of agriculture j towards market-oriented commodities such as oilseeds and pulses, horticultural crops, livestock and sericulture. Critical of the lack of j infrastructure and operational funds in Uttar Pradesh for research into these commodities, and of the lack of research focus and coordination, the project proposes to allocate over US$23 million to address key production and processing constraints, upgrade research facilities and human resources, and strengthen the research-management system. Proposals for research under the fund should aim to produce time-bound solutions to priority problems using multi-disciplinary, team-based approaches. The fund is open to applications from public-sector and private, commercial organisations, and from NGOs, or from consortia among these.

In reality, public-sector response to contract-funding possibilities has been less than enthusiastic. One reason for this is that performance-assessment criteria in the public sector have traditionally been based on some measure of academic performance (such as number of papers published differentiated by type of journal), with in some cases recognition for practical achievement such as the release of new varieties. This will have to change as self-earning requirements are imposed in the ICAR, and as the Johl Committee's provisions on, for example, retained earnings are accepted. However, if SAUs do not introduce similar changes, it would remain possible for scientists to be widely promoted on the basis of seniority in return for minimal amounts of research work-on the grounds that operational costs for research provided by the public sector are "unavailable".

Another problem is that many parts of the public sector research system-whether based in the ICAR or the SAUs-are unaccustomed to time-bound, problem-focused research of the kind likely to be financed by grant funds. Research of this type may involve, for instance, the screening of available information to identify what crop varieties already released might be appropriate for specified conditions. (This is very different from core-funded research of a type that allows researchers to develop new varieties largely in isolation from what already exists, and may not therefore be regarded as "pukka" research). Nevertheless, to farmers it represents an important function, and they expect researchers to do it. Performance-assessment and reward systems for researchers therefore need to be modified to encourage them to take up work of this kind. If they do, then this will create a demand which does not currently exist in the public sector for information on the characteristics of available varieties, and so will reinforce the creation of a detailed computerised database.

Several other preconditions also exist for the successful implementation of contract-research schemes of this kind. One is that ideas for research cannot be expected to emanate from low-resource farmers or farmers' organisations unless their inexperience in dealing with government officials has first been overcome. There are by now numerous cases in which NGOs have strengthened farmers' groups to overcome these shortcomings. However, NGOs themselves in many cases have limited technical expertise. In an effort to overcome this, part of the agricultural research fund established by the Ford Foundation in Udaipur has been set aside for independent agricultural experts to work with NGOs and farmers' groups to identify researchable problems and to set out research specifications for them (=> Box 3 and Section 3.3).

Box 3: Innovative approaches by the KVKs: The Vidya Bhawan Society KVK, Udaipur

Established in 1984, the VBSKVK has funding from ICAR of approximately Rs. 2 million per year to cover the costs of technical staff and core activities such as the Lab-to-Land programme and training of farmers and extension staff. Its search for external support for further activities relevant to its constituency helped it in obtaining an average of over Rs. 5 million per year from other sources. These include a number of 3-year programmes, such as demand-driven research and extension (Ford Foundation); watershed development, goat breeding improvement and women's development (all through Inter Co-operation); and watershed development (NORAD).

Under the Ford Foundation-supported work, the KVK has taken the initiative in setting up a forum, meeting 4 times a year, which provides the opportunity for the wide range of organisations involved in research and extension in the district to learn of each others' programmes, and to design joint activities. Under the same programme, the KVK is operating farmer-participatory-research activities with nearly 500 farmers in 25 villages. It administers a small agricultural fund, allowing NGOs and farmers' groups to commission research on needs that are not currently met. It publishes a newsletter, titled Recent Development, cataloguing interactions between NGOs and government research and extension services, and providing correspondence column for both sides. The KVK has also supported a number of innovative initiatives in district, including the use of para-extension workers and the participation of farm families in the DoA's block-level planning workshops.

The KVK's strategy envisages an expanded role in promoting client-oriented demand-driven research and extension, including :

- The assessment and demonstration to NGOs and other organisations of alternative adaptive research and extension methodologies and approaches.
- Support for human-resource development among the staff both of the KVK and of other organisations wishing to pursue similar approaches in the district.
- Development of information-sharing mechanisms between farmers, village groups, extension staff and researchers.
- Support for links between these groups and public-sector research and extension agencies.

It sees itself supporting the development of information-exchange centres at block level, which will allow exchange of information among farmers and government and non-government staff concerned with extension, and adaptive research in relation to farmer-participatory research with extension. It will establish a centre at the district level to interlink with these. The KVK will also provide training in farmer-participatory techniques in relation to research and extension.

2.7 Strengthening the Organisation and Management of Research

We argued above that a well-functioning, client-oriented research system is likely to provide relevant, practical and useful technologies to extension services, and so enhance the self-esteem of extension services and reinforce the links between extension and research. The above discussion has highlighted a number of constraints in the organisation and management of research which must either be addressed directly or circumvented if the efficiency and relevance of research is to be enhanced. Social-science skills have a major role to play in resolving these constraints.

These constraints include the following:

1. **Enhance the willingness of research staff to identify and respond to clients' needs.** This requirement poses some of the most intractable challenges, including the introduction of merit-based promotion, the redefinition of staff appraisal and performance criteria to reflect client-orientation more strongly, and the rigorous implementation of these. Many of these changes have been introduced in the private, commercial sector in India, and in larger NGOs. It is now for the public sector to follow suit. Only limited progress can be made with all the other recommendations made in this paper unless these challenges are met first.
2. **Fine-tune the financing of research.** Two types of challenge exist here. The first is of a facilitating and incentive-enhancing kind: close monitoring of the implementation of self-earning requirements and a gradual increase in these requirements are desirable, as is a rise in the proportion of research conducted under contract funding. These measures need to be reinforced by full implementation of the Johl Committee recommendations. The implications of these measures will need to be set out' clearly to institute directors to avoid the confusion currently existing in some parts over whether, for instance, contract earnings will lead to a directly corresponding reduction in core funding.

   The second challenge is more of a cost-saving and efficiency-enhancing kind. The flow of funds made available to institutes over the financial year clearly needs to be made more even.

   Furthermore, some consolidation and rationalisation of research infrastructure is required, particularly in the large number of regional or sub-stations operated by the ICAR centres and the SAUs. Cost savings in this area will contribute towards a further desirable goal: a shift in the balance of resource allocations by ICAR institutes and SAUs to allow more adequate funding for the operational costs of research. The demand for operational funds will rise substantially if, as this paper argues, more research is to be done on farmers' fields.

3. **Enhance the complementarity between ICAR and SAU research.** Previous efforts in this direction have demonstrated that only limited gains can be expected from formal provisions and over-arching plans. However, gains can be expected from the proposed strengthening of research-information systems. For instance, if scientists are required to use such systems to demonstrate that their research proposals take adequate account of previous or on-going research, then the extent of overlap at the project and programme level will be reduced. The Agricultural Research Information System project initiated by the ICAR during the Eighth Plan for computerisation of ICAR research institutes and SAUs needs to be strengthened in the Ninth Plan. Achievement of this depends largely on the quality of research management-which is discussed below.
4. **Allow problem-area focus to influence the structuring of programmes within institutes.** A research institute organised entirely on a discipline- or commodity-basis lends itself to the formulation and implementation of research deriving largely from 'scientists' own preferences. By contrast, one organised largely on the basis of carefully prioritised problem areas encourages disciplines to be drawn into addressing clients' problems. Certain institutes (eg, CRIDA, => Box 4) have made radical shifts towards organisation on a problem-priority basis, and provide a useful example to other institutes and programmes.
5. **Strengthen project-cycle management.** Major opportunities exist for strengthening the research-project cycle. At the preparation stage, clients need to be identified more clearly, and a careful needs diagnosis conducted. Researchers need to use an adequate computerised database of current and completed research projects to pitch their own proposals in the context of other research. Social scientists can help particularly in ensuring that proposals indicate more clearly than at present the anticipated economic and social impacts of the proposed research. The pro forma

for proposals should be modified to accommodate adequate statements of all of the above. As a medium-term goal, it is desirable to require all proposals to be designed in logical framework format ("logframe" => Box 5), to ensure their internal consistency along with a clear specification of purpose, outputs and activities, and the incorporation of appropriate indicators of achievement at each of these levels.

Box. 4 : Radical re-organisation of research structures : CRIDA

To meet the challenges of rainfed farming research, CRIDA's Perspective Plan (CRIDA, 1996) has streamlined its research activities and focused , them on eight "thrust" areas :

- Characterisation and efficient utilisation of basic resources like soil, climate and vegetation on agro-ecological basis by using frontier technologies like GIS.
- Conservation and management of soil and rainwater resources, with water as the nucleus of all production activities.
- Diversification of land use, with emphasis on producing fodder, fuel, wood and value-added products like dyes, bio-pesticides and other natural products for export.
- Utilisation of biodiversity for improved germplasm of annual and perennial plan species to enhance productivity and utilise the comparative advantage of rainfed regions.
- Improved energy management in both household and farm sectors to contribute to a better environment.
- Sustainability of the production systems by monitoring the build-up of soil quality through addressing location-specific challenges.
- Socio-economic factors, human resource development, and technology transfer involving farmers as partners in technology development.
- Interfacing research and development activities.

CRIDA sees multi-organisational consortia as essential to meet research requirements in these areas. Different organisations will have to pool their skills in addressing specific problems in multi-commodity, multi-disciplinary teams.

Box : 5 The Logframe

A logframe summarises the main features of a project and how to judge its progress. It consists of a 4 x 4 matrix. The rows consist of:

1. The overall Goal of project.
2. The project's immediate Purpose, through which it contributes to achievement of its Goal.
3. The Outputs needed to achieve the Purpose.
4. The Activities needed to achieve the Outputs.

The columns in the matrix show :

A. A narrative Summary of the Goal, Purpose, Outputs and Activities.
B. The Indicators that can be measured to show whether the Goal, Purpose, etc, are achieved. These are sometimes called "objectively verifiable indicators" because they should be objective, quantitative wherever possible, and the quality and timing should be specified. These attributes are commonly known as "QQT" (quantity, quality and timing).
C. The Means of Verification : the specific sources and methods that can be used to obtain information on the indicators.
D. The Assumptions made about matters outside the direct control of the project.

The logframe helps to make the project design more transparent by clarifying the reasoning behind the project. The cells in each row have the same relationship to each other as shown in Figure 3. The logframe can be read from bottom to top, as indicated in the Figure 3. If the Activities (cell A4) are carried out, and the relevant Assumptions are valid (cell D4), then the project will achieve the Outputs in cell A3. Similarly, if the Outputs in A3 are achieved, and the related Assumptions hold (D3), the project will achieve its purpose (A2). The two middle columns (B and C) show how to measure whether the Summary at each level is being achieved.

It is also possible to construct (and real) a logframe from top to bottom. Begin by deciding on the broad Goal : then determine what narrower Purpose the project should have that will help achieve that Goal. Decide on the Outputs needed to achieve each Purpose, then decide the Activities and inputs required to achieve the Outputs.

Though the convention is to have only one Goal and Purpose for each project, in all but the simplest projects, there will be several Activities and Outputs. The logframe accommodates these by dividing each row horizontally into several parts.

Source : Farrington and Nelson (1997).

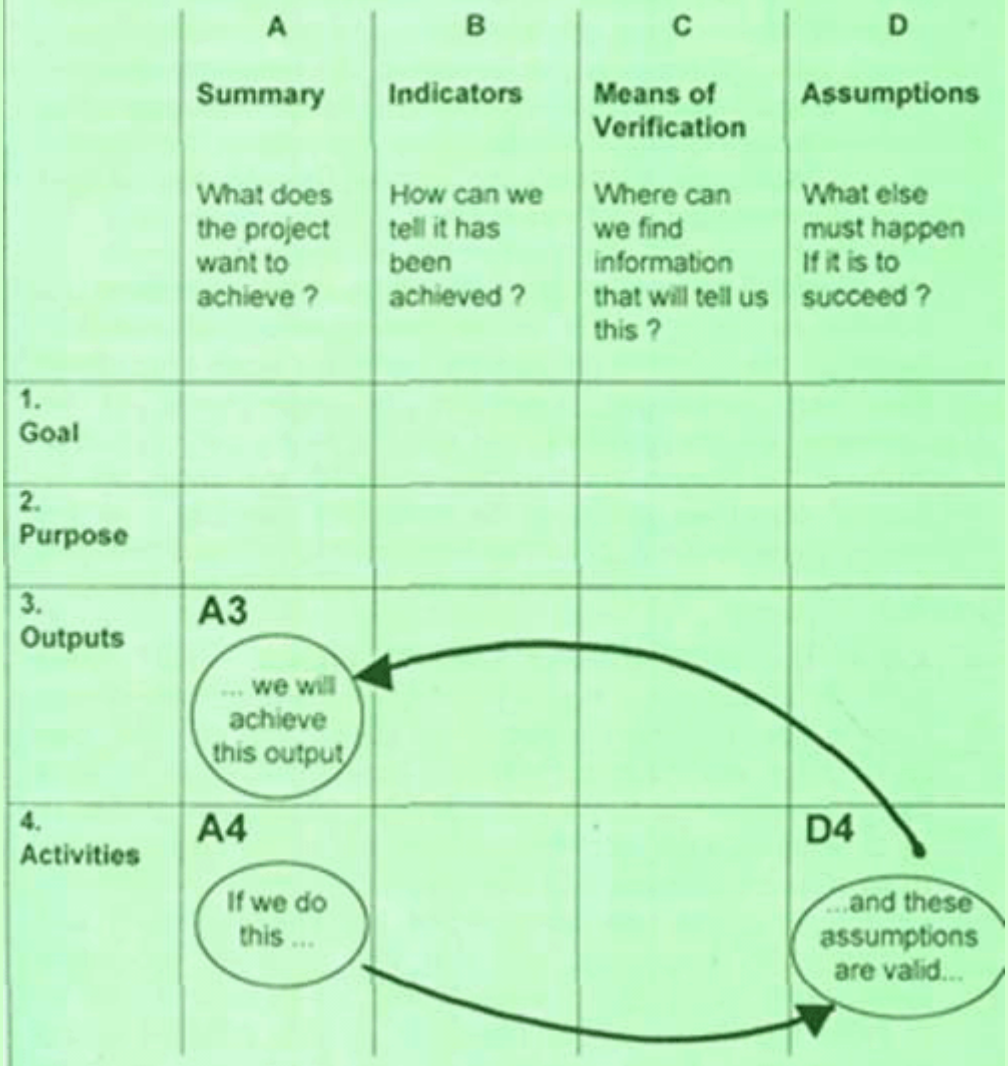


Figure 3 : Relationship between rows and cells in a logframe

Procedures for the approval of research projects need to be strengthened. In most cases, ICAR scientific research committees consist only of the full complement of research staff. This has three negative consequences: (i) it is difficult to reject proposals in this forum, since to do so would cause the scientists concerned to lose face in the presence of their peers; (ii) certain disciplines are likely to be under-represented on the SRCs, especially where, as is the case with social scientists, most institutes employ only few, often junior, members of staff; and (iii) clients are poorly represented. As research becomes more client- and problem-focused, it is important that

representatives of the client base (eg, the private, commercial sector, NGOs or farmers' groups, as appropriate) should influence the selection of projects.

The implementation of projects can be greatly strengthened. As a minimum, there needs to be continuing consultation with clients as the research progresses. For many types of research there are compelling arguments for experiments to be conducted on farmers' fields and with the strong participation of farmers. The progress of projects-especially the longer ones-against objectives needs to be monitored carefully. At the review stage, lessons for further work need to be drawn out, and feedback from clients needs to be encouraged and acted upon.

6. **Adjust the skills balance within institutes.** We argued forcefully above that a higher proportion of research for rainfed farming needs to be conducted off-station and on-farm, that researchers will have to make a substantial effort to elicit farmers' needs, that farmers' risk-averting strategies will have to be understood if the recommendations arising from research are to be relevant to them, and that greater sensitivity is needed in ensuring that the new technologies are environmentally and institutionally sustainable, and that they generate acceptable distributional equity. Social-science skills are needed to meet all of these requirements. Our interviews, already provided strong evidence that social scientists in an ICAR institute have contributed enormously to the successful orientation of research. For instance, close relations between social an technical scientists at the CSSRI over two decades led to recognition that farmers are much more willing to take up soil improvement measures if they include an income-earning component. This led to a wide re-orientation of work towards, for instance, crops capable of tolerating or improving adverse soil conditions which would provide farmers with at least some income, in place of, physical measures (=> Box 6).

   Three ways need to be pursued for strengthening social-science skills in the ICAR institutes and programmes for rainfed farming research, (i) The present allocation of only 7.5% of ICAR staff as social scientists needs to be increased substantially to permit the employment of more (and more senior) social scientists, (ii) Regular interaction needs to be organised among the social scientists to promote cross-learning from their experiences and to familiarise them with new techniques as they become available. NCAP might play a role in co-ordinating this, (iii) Biophysical scientists themselves need to develop skills in some areas of concern to social scientists (needs assessment, the understanding of risk, and so on). How this might be done is discussed below.

7. **Human resource development.** Strongly client-oriented scientists will wish to be updated with skills, some of which are generic, but all are essential to research for rainfed farming. These include:

- Needs-assessment techniques, including the role of such methods as participatory rural appraisal.
- The preparation of research proposals, including logframe formats if, as recommended, these are adopted by ICAR.
- Management of the research-project cycle, from preparation through implementation to review, including the conduct of participatory, on-farm research and the eliciting of feedback from farmers.
- Understanding of farmers' risk-averting practices and their implications for the design of research and the formulation of recommendations.
- Improved understanding of current neo-liberal concepts concerning the respective rotes of government, commercial and non-profit organisations in technology generation and dissemination for low-resource farmers.

- The preparation and management of research and service contracts with commercial organisations and NGOs; the management of patenting, licensing and royalty arrangements;
- Modes of working in multi-organisation partnership with research and extension agencies within and outside the public sector (=> Section 4.3).

Box 6: Innovative deployment of social scientists in ICAR institutes

CSWCR&TI has six economists and four extension specialists from a total sanctioned staff of 131. Economists have been strongly represented on ; contract research and consultancy teams. They also have a strong publications record. Among the publications of direct practical value of other scientists is the guide concepts, methods and case studies in watershed development. Economists advise other scientists on the data sets required to assess the effectiveness of their work. Contracts currently account for some 10% of CSWCR&TI's turnover, and the director of CSWCR&TI sees the preparation of time-bound, client-focused proposals for contract work as an area of major staff-training needs.

NDRI earns approximately 8% of its turnover from contracts of various kinds. Again, the proportion of economists is fairly high, accounting for 15 to 230 sanctioned posts. The director of NDRI perceives that contracts from the private, commercial sector will continue to offer opportunities to NDRI, and would like to see research staff in general, and economists in particular, acquire the business-management skills necessary to allow closer orientation the needs of this sector.

In **CSSRI,** Technology Evaluation and Transfer is one of the institute's four major divisions. Economists have completed a major project entitled "Socio-economic constraints to technology adoption". Economists and biophysical scientists have a long history of close working relations in the institute. Substantive evidence of the success of his relationship is found in the greater role allocated to varietal improvement in the institute's portfolio. This results from the economists' showed that farmers were much more willing to adopt those technologies able to cope with adverse soil conditions which at the same time generated a modest income.

By comparison, the proportion of social science staff at CRIDA and IGFRI remains low. However, the director of CRIDA sees several important future roles for social-science skills in : (i) participatory approaches to needs assessment and experimentation, (ii) the promotion of joint action among farm households (especially to improve the efficiency and sustainability of common-pool resource management), and (iii) as a component in the multidisciplinary teams necessary to study the diversity of low-income rainfed farms and to take into account the role of, for instance, livestock in mixed farming systems. CRIDA plans to allocate 10% of its budget to human-resource development, including the development of staff skills in teamwork and participation.

In Box 6, we identified how social scientists have performed innovative roles in some institutes. For instance, they have played a key role in developing business strategies in NDRI's work for commercial dairy-processing companies; at CSSRI, they have helped to re-orient research priorities, and in CSWCR&TI they have contributed to economic assessment of aspects of natural-resource management. Elsewhere, however:

- There are few social scientists in ICAR institutes; within this, there is a disproportionately high representation of economists with very few in such disciplines as sociology or anthropology.
- Social scientists do broadly two types of work: providing a "service" function to biophysical scientists by performing basic economic analysis in support of their projects; and conducting farm surveys, often to demonstrate the impact of one or other technology, and publishing the results of these in academic papers.

- In many institutes, social scientists are a small and relatively young part of the scientific cadre, and often feel a sense of professional isolation.

We envisage the contributions from social scientists in the ICAR system as given in Box 7.

The curricula used by institutes mandated to provide graduate and postgraduate training for scientists require revision to ensure a uniformly high standard of training in these new areas. For scientists in post, organisations such as NAARM should give in-service training on a regular up-date basis. Prior measures need to be taken to ensure that the faculty of the organisations concerned are familiar with the issues and have adequate teaching and training materials.

Programmes for the exchange of scientists between the ICAR institutes on the one hand, and private commercial organisations and the larger technology-oriented NGOs concerned with rainfed farming on the other, would be of considerable benefit in providing practical experience to reinforce this training.

Box 7 : Potential social-science contribution in agricultural research

We have argued in this report that much rainfed farming is characterised by a number of biophysical and socio-economic factors, including:

- **High level of risk.** Farmers have to be risk-averse to survive, and this places limits on the types of technology likely to be acceptable to them. '
- **A high proportion of female labour** (especially in the management of livestock and the acquisition of fodder and fuel, often from common-pool areas); a high proportion of female-headed households, especially in areas where out-migration is common.
- **A strong contribution to livelihoods from common-pool resources,** but low productivity of labour and land, and difficulty in maintaining productivity levels in the face of increasing pressure on both private and common lands.

These factors argue for strong involvement by social scientists in ICAR institutes in understanding constraints to technical change and in advising directors and senior staff in the selection of new research topics. A further argument for this involvement is that ICAR institutes are under pressure to generate proportion of their own revenue, for which they must become increasingly oriented towards the needs of clients, and social scientists have specialist skills in identifying these needs. '

We believe that a fundamental shift in the balance of social scientists' work is needed in ICAR institutes - one largely foreshadowed by what is already occurring at NDRI, CSSRI and CSWCR&TI. This shift is away from social-science analysis of the effects of biophysical research as it nears completion, and towards the improved selection and design of scientific projects to meet clients' needs, and so create better prospects for technology uptake. Topics for investigation in this context include :

- Farmers' risk-aversion practices and the opportunities and constraints they offer for new technologies; the implications of risk aversion for level of purchased inputs (seed, agrochemicals, equipment) likely to be acceptable.
- Management of the farm household's labour economy, including the opportunity cost of male, female and child labour at various points in the season, including periods when migration is usually undertaken.
- The extent to which proposed innovations rely on joint action among farm households; the prospects of achieving and sustaining such action.
- The anticipated distributional effects of technical change between men and women and between wealthier and poorer households, including the landless.
- The social, cultural and economic factors governing the work of women; the range of household responsibilities falling to women, and the implications of all of these for the

types of technology that will have a positive effect on women's livelihoods.

For successful research into these topics, there is a need for:

- Joint efforts of biophysical and social scientists in addressing many of these topics.
- A shift in the balance of social-science skills, to include more anthropologists and sociologists.
- Enhancement of the skills and confidence among social scientists, by regular ICAR-wide workshops and networking, so that they are able to learn not only specific techniques, but also ways of inserting their work strategically into the selection and design of biophysical research in their institutes.
- A willingness of directors to take the work of social scientists seriously, and to incorporate its findings into the selection and design of research.
- A change in the performance-assessment criteria for social scientists, to reflect the fact that in their new role they will publish less but provide more of a service function to their institutes.

Overall, collaboration among different kinds of institutions in research (eg, SAUs and ICAR institutes) remains weak outside formal mechanisms such as the AICRPs.

One problem is the fear of the possible financial implications on travel and contingency. Under the prevailing pressure on resources, directors are not willing to spend on scientists from other institutions. There are also fears of credit sharing. The potential benefits arising from savings from enhanced quality of research and reduced duplication of effort are ignored at the level of institute directors, yet have important implications for the system as a whole. There seems to be a lack of understanding of how scientists' time should be budgeted among the departments of the same institute and across institutions. The system should provide for hiring scientists across SAUs and ICAR institutes. This may also resolve to some extent, the non-availability of experts in different disciplines in remote and difficult areas.

3. ORGANISATION AND MANAGEMENT ISSUES IN EXTENSION

3.1 The Organisation of Extension Services at State Level

Extension falls primarily within the mandate of the individual states, and so there are variations in practice from one state to another. Most have used the training-and-visit system of extension, (whose features are now well known), and they are still following T&V's basic framework with some modifications. A review of evaluation . studies on the T&V system revealed its impressive gains in irrigated areas, because of the similarity between the agro-ecological conditions where technologies are generated and where they are to be used, and the favourable socio-economic situations and developmental infrastructure for their wider uptake. But there are serious limitations in rainfed areas, where the above conditions do not hold. The major weaknesses of existing extension approaches (based on field visits to Rajasthan and Maharashtra) are summarised in Table 5.

The states have responded in part to some of the above shortcomings. The following section draws on the experiences of Rajasthan and Maharashtra, where rainfed farming predominates.

3.2 Lessons Learned and New Approaches

One response was to make extension "broad-based": ie, adding advice on land- and water-use, watershed management, agro-forestry and fodder production, in addition to the traditional extension focus on cereals, oilseeds and pulses. One intention behind this modification is that it should permit government departments such as horticulture, animal husbandry and soil conservation to formally delegate responsibility for extension work to the DoA, which generally has the largest network of field staff. However the results of broad-basing have not been encouraging, considering the poor technical background of VEWs and weak linkages existing between different line departments.

Table 5 : Weaknesses of existing extension approaches

Problem area	Description
Spread	Technology transfer remains more or less restricted to contact farmers, partly because of faulty selection of contact farmers and the underlying assumptions. Visits become routine as VEW has no new knowledge or skills to offer. VEW and AAO/AO positions in many remote areas remain vacant throughout the year.
Content	Emphasis on field crops; neglect of other crops and enterprises. Low relevance of technical messages to low-resources, risk-prone farming conditions, as they had almost universally been developed from research station experiments. Information delivery as the major role of VEW (which would work well in individual-based technology) and no programme for group-based technologies (such as land-and water-use management) that are important in rainfed areas.
Training	Fortnightly trainings are poorly conducted. SMSs could not be chosen and posted to fit their role. Inadequate subject-matter knowledge of SMSs result in routine sessions and an adverse impact on upgrading and skills of VEWs.
Linkages	Failure of district-level monthly workshops and the Zonal Research and Extension Advisory Committee (ZREAC) meetings held once in a six months to achieve their intended purpose. Poor representation of line departments, and training sessions commonly handled by junior and inexperienced university scientists. Less-than-optimum outcomes, with both sides blaming each other for failure. Linkages at the state level, with wider representation of senior university and state department-of-agriculture officers, bring out serious problem for research-but these are not followed up adequately by either side. Little is done to set research priorities for next year. No specific attempts to acknowledge or collaborate with extension efforts of other agencies.
Operational issues	Total dependence on oral communication. No periodic upgrading of mass-media facilities. Severe shortage of operational funds affecting mobility and other field operations, resulting in inefficient use of human resources.
Source: Synthesised from various reports of the Department of Agriculture, Government of Rajasthan and Government of Maharashtra.	

The need for a group approach in extension began to be accepted later. The Group Farming Programme in Rice Cultivation initiated in Kerala was a notable example. In Rajasthan, the most significant change was the introduction of group-based approaches to extension, in which Kisan Mandate, comprising a group of 20 farmers, were formed in every VEW circle. To facilitate other farmers to meet and discuss with VEWs, Kisan Seva Kendras were opened, whereby the VEW would be available during a specific period during the day of his visit.

NGOs also started to play a greater role in technology-transfer activities by the end of the 1980s. To increase the involvement of NGOs in efforts to strengthen the research-extension delivery system, a pilot central government scheme, agricultural extension through voluntary organisations, was launched in 1994-95 (=>Box8).

The Department of Agriculture in Rajasthan has been experimenting with newer arrangements of providing extension.

One major decision in this line was to withdraw the existing extension officials from certain assistant agricultural officer (AAO) circles, and to hand over extension responsibilities there to NGOs. Thus the extension responsibilities at Sivadaspura AAO circle in Jaipur district were handed over to the Social Policy Research Institute, an NGO. Similarly Ras Morarka GT Foundation and Research Centre was given one AAO circle in Jhunjunu district for extension activities. Basically these NGOs are implementing the same programmes of the public system in these areas, with the similar staff positions appointed by the agency. But they are expected

to try innovative approaches in implementing the same programmes. Their results would decide the future of such programmes.

Assistance is being provided to some other NGOs also for specific extension activities, such as grain storage. In animal husbandry, a heifer development project has been given to Gayatri Siksha Sadan Sansthan (GSSS) to implement this programme in Saroda block of Udaipur district. In a short period, GSSS succeeded in obtaining critical assistance such as credit and marketing, and provided diagnostic and disease-treatment facilities by establishing and managing a veterinary polyclinic.

Box 8 : Agricultural extension through voluntary organisations

The major objective of the scheme, launched in 1994-95, is to involve NGOs in agricultural extension with a view to integrating their efforts with those of the main extension system. The scheme is being implemented on a pilot basis in two districts each in six states: Bihar, West Bengal, Andhra Pradesh, Madhya Pradesh, Karnataka and Uttar Pradesh, and one district each in Manipur and Tripura. The scheme is funded by the Directorate of Extension, Indian Ministry of Agriculture, on the basis of 100% assistance to NGOs through CAPART. A broad ceiling is fixed at Rs 5 lakhs per annum per district. The NGOs are being funded for documentation of farming systems at the micro level, audio-visual preparation and procurement, training and demonstrations, farmers' visits to research stations, administrative support and contingencies.

Experience is encouraging, both in terms of physical targets and in integrating NGO efforts with those of the main extension system.

The impact of the scheme clearly points to issues like :

1. An increased awareness among farmers in the project area.
2. Increased efforts in trying out new technologies.
3. Greater involvement of farm women and farmers from weaker sections of the society.
4. Improved linkages between NGO activities and research.
5. Increased use of electronic media, print and films in field extension.
6. Systematic approaches towards farmers' training.

This scheme is proposed for expansion in the IX Five Year Plan.

Source : Agenda notes of the review Workshops on Agricultural Extension through Voluntary Organisations, 12-13 September (1996), Directorate of Extension, Ministry of Agriculture, Government of India.

Para-Extension Workers (This section draws heavily on Alsop et a/. (1996).)

Although public-sector extension services in theory have a strong cadre capable of reaching down to village level, in practice it is extremely difficult to maintain an effective service in many rainfed areas, especially in predominantly tribal districts. Poor communications and transport infrastructure, weak health and educational facilities, and remoteness from district or state capitals (in which key contacts and information on promotion or transfer prospects are located): all conspire to make appointments on the lowest rung of the public-extension service (agricultural supervisor) to difficult areas appear as "punishment postings". These positions may be filled immediately after a recruitment round, since they provide candidates with an opportunity to gain a foothold in public service. However, as soon as they are appointed they seek transfers to more desirable locations and as estimated, for these reasons, some 40% of the AS positions in Udaipur district, having large pockets of tribal population, are chronically vacant. In many other positions, the rate of staff turnover is so rapid as to render the post ineffective.

Many NGOs in Udaipur district have proposed an alternative scheme in several areas to overcome lack of manpower and other constraints. In brief, their proposal is based on the principles of farmer-led extension (Scarborough et al., 1997), where farmer representatives, elected by farmers themselves, make contact with either ASs in neighbouring areas, or preferably, with officers at a higher level (assistant agriculture officers) to draw down advice or technologies relevant to local needs. A wide variety of models of farmer-led extension have been tried in countries of Asia, Africa and Latin America, but the most successful have two features in common. One is that farmer-extensionists (referred to in the Udaipur case as para-extension workers, or PEWs) have to be remunerated if they are to operate on anything other than a very small scale. The second is that they need initial support to gain confidence to deal with government officials. This second requirement is met in many cases by a programme of training and support provided by NGOs. The former requirement may be met initially by special project funds. In Udaipur, grant applications have been made by NGOs working with farmers' groups and PEWs for the funds for privatising agricultural extension under the government of Rajasthan's World-Bank-supported Agricultural Development Project. Ultimately, there is no reason why they should not be met through a combination of contributions from government, drawing on the funds saved through the persistent AS vacancies, plus contributions from the farmers' groups being served by the PEW.

Apart from meeting the immediate requirements of obtaining advice and technologies from nigher levels of the extension service, the PEW approach has a number of other potential advantages:

- Where researchers have taken an interest in participating with farmers in the setting of research priorities, the testing of technologies and the feeding back of farmer' responses into refinement and adaptation of the technology, there PEWs provide a convenient and representative way of incorporating farmers' views into these facets of research.
- Where farmers and supporting NGOs seek to improve local-level seed supply, PEWs can play a lead role in, for instance, establishing contact with local commercial agencies, contacting NGOs, special projects and the like to identify what potentially appropriate varieties exist outside the public-sector seed-supply system. They can also visit NGOs and farmer groups elsewhere to learn from existing approaches to local-level seed supply.

Despite their value in delivering farm-related information and acting as a link with research and extension, PEWs still have a limited base of technical knowledge. They, therefore, cannot be expected to contribute much to the design and implementation of group-based and knowledge-intensive technologies.

Multi-agency approaches to research and extension

We argued at the beginning of this paper that the complex, diverse and risk-prone conditions characterising much rainfed farming are difficult to replicate on-station, so that much research needs to be conducted on-farm and with farmers. In addition, many farmers have long been outside the political and economic mainstream, and so are unable to assert their requirements when talking to government officials. Ideally, scientists' training should include skills in both of these areas: in on-farm trials with farmers, and in the use of interpersonal skills to elicit farmers' requirements. Additionally, social-science skills in both the ICAR and SAD system should be strong enough to support and refine these skills. In reality, both of these requirements are unlikely to be met in the short or medium term, and a strategy of multi-agency collaboration with NGOs and farmers' groups has been adopted in some areas-in part to make good these shortages of skills, though it also has wider advantages. For instance, NGOs have skills in group formation and the promotion of joint action which government services are unlikely to develop. Joint action is necessary in certain agricultural operations, such as pest management, the management of irrigation supplies, and the achievement of the necessary levels of isolation for seed-production plots. It is also necessary for the sustainable management of common-pool resources and their integration with the management of private agricultural land on a micro-watershed basis. Experience in this regard is given in Box 9.

The central premise underlying MANAGE's training in watershed management is that the technical aspects are less important than the participatory efforts. These are necessary to get joint action. on common-pool resources organised, and to be able to identify and resolve potential conflicts over common-pool resource management-before on-the-ground efforts to improve resource management are made. MANAGE's approach makes a clear distinction between two aspects of extension which have been conflated in conventional approaches: skill development and information dissemination. MANAGE argues that the latter is now largely (and more cost-effectively) transmitted by mass media than by extensionist-farmer contact. The former, it argues, is best spread by farmer-to-farmer contact, with input from government technical agencies, which limit themselves to expanding the basket of choices available to farmers.

MANAGE's concept of "distance learning" embraces both the use of multi-media at local level, and the spread of skills via farmer-to-farmer contact. MANAGE's view is that, whilst some agricultural research in India has been problem-driven and so has at least put additional choices "on the shelf, virtually all extension has been top-down, and driven by targets.

The last decade also saw the emergence of numerous organisations in the field of transfer of technology. This includes, other than the public sector, organisations in the private industry (both in inputs and processing), NGOs, farmers' associations, cooperatives and private consultants. Maharashtra is one such state where several new alternatives have come up. Pune, a major horticultural district, provides a glimpse of this scenario (=> Box 10). However, co-ordination between these organisations, wherever it exists, is only ad-hoc. There is no mechanism at present to facilitate joint planning of activities at the district level.

Box 9 : NGO - government interface in extension 1

Experience in one district (Udaipur) in the promotion of multi-organisational approaches to research and extension over the last 3 years indicates both the : strengths and the continuing challenges of the approaches. There have been successful cases where farmer groups working with NGOs have readily taken up the demonstrations being promoted by the DoA. In other cases, extension services have provided support in response to specific requests, but have found it difficult to respond on matters outside their targeted programmes. In further cases, the interaction has scarcely progressed beyond the stage of mutual suspicion. The participation of scientists from Rajasthan Agricultural University has been minimal, and NGOs have found it virtually impossible to influence the research agenda of the Zonal Research Stations.

Efforts to monitor the processes of interaction provided especially the smaller NGOs (which were unaccustomed to dealing with senior level civil services) with the self-confidence to provide strong feedback (including in some cases vigorous complaints) on how collaborative work had progressed. The KVK in Udaipur played a central role in publishing notes on NGO-GO interaction (in the form of the newsletter Recent Developments), and in providing a regular forum meeting where the two sides exchanged information and experience. The DoA in the same district played a key role in developing the concept of para-extension workers.

The somewhat leisurely pace of interaction between NGOs and government research and extension services in this rather unstructured example contrasts markedly with the much more structured interaction pursued within the Indo-German Watershed Development Project in Maharashtra. Here, NGOs have to fulfil certain basic conditions before they are allowed to work in support of village-level organisations within the project. Technical plans for rehabilitation have to be drawn up jointly between the NGOs and village organisations, with the support of approved technical specialists working based on guidelines provided by the project. Although the highly structured nature of this project may give cause for concern to some NGOs, it does at least appear to lend itself to rapid and participatory rehabilitation: some 90,000 ha of micro-watershed having been rehabilitated in 5 years (Farrington and Lobo, 1997).

3.3 ICAR and Extension

Although extension is predominantly a state responsibility, central government, in the form of ICAR, retains responsibility for "frontline" extension, and the ICAR continues to make major financial contributions to the KVKs (Farm Science Centres), which have responsibility for demonstrating and providing training in new techniques. From the beginning of the Eighth Plan, KVKs were mandated to:

- Collaborate with the SMSs of the SAUs, scientists at the ICAR and the SAUs (especially their zonal and other research stations), and with state extension personnel in "on-farm" testing, refinement and documentation of technologies for developing region-specific sustainable land-use systems.
- Organise long-term vocational training courses in agriculture and allied areas for rural youth, with emphasis on "learning by doing" to generate self-employment opportunities.
- Organise front-line demonstrations on various crops to generate production data and feedback information.
- Organise regular training to update state extension personnel in advances in agricultural research.

In brief, KVKs are to provide a key facilitating role in the refinement of technologies to specific conditions, by acting as a two-way link between research and farmers. The staffing provided by the ICAR includes the disciplines of agricultural extension, agronomy, plant breeding, horticulture, veterinary and animal sciences, home science and plant protection.

Current issues

The ICAR's involvement in extension activities started with the National Demonstration Scheme initiated in 1966. Since then, innovative programmes have included the Operational Research Project (1972-73), Krishi Vigyan Kendra (1976-77), Lab-to-Land Programme (1979), All-India Co-ordinated Research Programme for the Upliftment of Scheduled Castes (1979), and the Tribal Area Research Project (1979). From the Eighth Five Year Plan (1992-97) all these programmes were merged into KVKs. All have been 100%-funded by ICAR since their inception.

Box 10 : Institutional pluralism in extension : Pune district, Maharashtra

Over the last decade or so, in a significant diversification away from the T&V system, several organisations have taken on roles in transferring farm technology in Maharashtra.

MAHAGRAPES, a confederation of 17 grape-growers' co-operative societies established in 1991, is a major grape exporter. The quality-control officers (who are primarily agricultural graduates) stationed at each of these societies provide technical assistance to farmers on soil testing, irrigation methods, use of fertilisers and pesticides, and quality specifications for export. MAHAGRAPES arranges finance to develop pre-cooling and cold-storage facilities in the societies, provides market information, and helps farmers realise higher prices for their produce.

Maharashtra State Agricultural Marketing Board, headquartered at Pune, facilitates and co-ordinates the functions of market committees. In addition, it organises seminars and workshops on fruit crops and floriculture. It also scout technologies from institutions in India and abroad on different aspects of cultivation and post-harvest management, provides market information, and sponsors training programmes for farmers.

Indian Farmers' Fertiliser Co-operative Limited (IFFCO), a major fertiliser co-operative, arranges meeting to educate farmers on cultivation practices, conducts demonstrations and participates in exhibitions and seminars. Each district has 2-field officers, who are agriculture graduates. They also implement a programme for village adoption.

Maharashtra State Grape Growers' Association. With an estimated membership of 17,000 grape growers, the association is very active in promoting grape cultivation in the state. It organises regular group discussions and seminars, and publishes leaflets, booklets and a monthly magazine, Draksha Vrutha. It imports plant-growth regulators and other materials for increasing the shelf life of grapes. It has an independent research and development wing and owns facilities for soil, water and plant analysis.

Agricultural Development Trust (ADT) Baramati, established in 1971 promotes improved cultivation practices. The KVK established at ADT in 1992 offers vocational training programmes. Trainings on sericulture, goat and sheep husbandry, poultry and nursery techniques are in great demand.

Vasantdada Sugar Institute (VSI), originally founded as the Deccan Sugar Institute in 1975, is involved in teaching, research and extension in sugarcane production and sugar technology. Apart from regular certificate and diploma programmes, VSI organises special training programmes on sugarcane farming, in which 500 cultivators sponsored by sugar factories are trained in the latest cane-production technologies.

Bharatiya Agro Industries Federation (BAIF) is a non-profit development research foundation, established in 1967 in Pune. From a modest beginning with dairy-cattle production programme, BAIF later diversified to embrace animal health, nutrition, afforestation, wasteland development and tribal rehabilitation. The Central Research Station at Urlikanchan, Pune, supports cattle breeding in six states. In Maharashtra, BAIF is a major' training and implementing agency in areas such a cattle development, water-resource development and empowerment of women.

Input agencies also undertake training and consultancy programmes. Ajay Biotech, a firm producing and marketing, bio-fertilisers and pesticides, trains farmers how to use these inputs. Kumar Genetics, a firm supplying tissue-cultured planting material for fruits and flowers, advises farmers on how to grow them. The Pune College of Agriculture and research stations of the university in Pune district also do limited extension activities.

ICAR now supports 261 Krishi Vigyan Kendras, of which 27 are in ICAR institutes, 139 in SAUs, 86 in NGOs, and the remaining nine in central universities, agricultural colleges, etc. Another 58 KVKs are to be established by upgrading existing Farmers Training Centres through NATP funding. On average, ICAR spends Rs 32 crore yearly on the KVKs (Eighth Plan). In addition, ICAR spends more than Rs 10 crore on technology assessment and refinement through institute-village linkage programmes in selected centres. The proposal was first implemented in rabi 1995-96 on a pilot basis, and was expected to cover three seasons at 42 selected centres, with subsequent up-scaling in the National Agricultural Technology Project.

The increasing costs of establishing and maintaining Krishi Vigyan Kendras became an issue of serious concern by the late 1980s. ICAR Plan funding for extension has increased from 3% of all funding under the Sixth Plan to over 12 % in the Eighth Plan. At present, the Council's decision is to fund existing KVKs and those to be started from 1992-93 for only 10 years (100% for the first 5 years, 75% for next 5 years). ICAR's decision to phase out its funding gradually has invited criticism from the existing KVKs and the political establishment.

Several committees have looked into the functioning of the KVKs. The Evaluation Committee on KVK (1980), the Joint FAO-ICAR Committee on KVK (1986), the Quinquennial Review Committee on KVK (1993) and the Committee on HRD through KVKs and TTCs (1996) are some. The review committee on the ICAR extension system (S. S. Surjewala Committee, 1996) has also looked at the functioning of the KVKs. One conclusion that can be drawn from all these reports is that KVKs have been an institutional innovation and have contributed towards training farmers and rural youth. Visits made by the team to three KVKs based at NGOs Vidya Bhavan Society (Udaipur, Rajasthan), Youth for Action (Mehboobnagar, Andhra Pradesh), and Agricultural Development Trust (Baramati, Maharashtra)) also support this.

However there are weak KVKs, too. Following a visit in 1994, Van den Ban noted that many KVKs are under-resourced and have inexperienced staff. The World Bank (1990) noted that many KVK training courses were under-subscribed, raising doubts about their relevance. There is a need for an objective and scientific evaluation of all KVKs so that a case-by-case assessment will guide the type and level of any further support.

KVKs are mandated to cover hands-on training for farmers, farm women, rural youth and village extension workers on different aspects of agriculture, (production, management, protection, processing, etc), animal husbandry and rural enterprises. There is no other comparable organisation (infrastructure and expertise) existing at the district level, and this itself is a very strong argument for the KVKs to continue and expand.

Some argue that this is basically a function of the state department of agriculture, and that there is duplication between ICAR extension through KVKs and the extension activities of line departments. Our experience is that the state departments of agriculture, following the T&V pattern, have been concentrating on information transfer and implementation of other schemes. The Farmers Training Centres have generally performed poorly, and the present proposal is to upgrade them to KVKs. As the technological options in rainfed agriculture are going to be knowledge-based, resource-sharing and complex, farmers and the facilitators need to be provided with hands-on training. Ideally, these are the functions that the central Ministry of Agriculture or respective state departments of agriculture ought to perform.

The Surjewala Committee recommended 100% funding to KVKs in the Ninth Plan, a one-time project fund for generation of income (returnable after 5 years in instalments), continued funding of 75% for the next 5 years, and 50% funding forever. If the ICAR has to manage these KVKs, it needs additional support, otherwise its allocation for other functions such as research and education would be affected adversely. The issue is, who would support the KVKs.

KVKs should be in a position to generate a part of their resources from the sale of planting materials and other produce from their farms. Training programmes can also be charged for to some extent. KVKs are also encouraged to seek long-term funding relationship with local constituencies, such as NGOs, and with national and international organisations. By these means, KVKs would be able to meet at least their operational expenditures other than salaries. Salaries would have to be provided by ICAR through a grant or special allocation from the Ministry of Agriculture or state department of agriculture, or even from the Ministry of Rural Development.

The financial allocation to the different departments within Ministry of Agriculture is given in Table 6.

Table 6 :
Financial allocation to Ministry of Agriculture departments, 1995-96

Department	Rs. (crores)	Percentage
Department of Agriculture and Cooperation	1,490	69.5
Department of Agricultural Research and Education	310	14.5
Department of Animal Husbandry and Development	344	16.0
Total (Ministry of Agriculture)	**2,144**	**100.0**

While DAC gets about 70% of the total MoA allocation, the ICAR share is less than 15%. Out of this, ICAR spends more than 12% on the KVKs, which are essentially an extension function. In the KVKs, 1 ICAR has institutionalised and perfected an innovative set-up for transfer of technology, and the DAC may now come forward to] support it. Rs 32 crore of ICAR's expenditure on KVKs would presently come to less than 3% of the DAC budget.

The current ICAR funding for KVKs is under review and is likely to be reduced. The goal set in the Quinquennial Review of KVKs in 1994 of establishing one KVK per district (ie, approximately 500 in total) by 2002 is therefore unlikely to be achieved.

A far-sighted move on the part of ICAR was to locate a number of KVKs (86 in all) at NGOs, in the belief that NGOs' ability to interact with farming communities, especially in the more difficult rainfed areas, was key to the identification of farmers' needs. However, the performance of the NGOs concerned is mixed. Some, such as the Vidya Bhawan Society in Udaipur (=> Box 3) have provided extensive support to their KVKs. Others, however, suffer from the common NGO characteristic of limited technical orientation, and so have found it difficult to develop a strong working relationship with-their KVK. The World Bank (1990) report noted that many of the long-standing programmes that had been allocated to KVKs, including the Lab-to-Land programme, are "paternalistic in conception and execution", taking scientific endeavour well beyond its accepted mandate. In the flush of enthusiasm for the Zonal Research Stations then being established, it also argued that all ICAR technology-transfer projects be wound up, or continued by the states where they found it desirable, under the mandate of the ZRS. As mentioned above, others have questioned whether there is duplication of effort between the KVKs and Farmers Training Centres of state governments.

A number of changes have recently been made in ICAR's relations with the KVKs, most of them relating to funding. By March 1997, it was envisaged that ICAR support would be withdrawn from the 37% of oldest KVKs, with withdrawal from a further 33% by 2002 and the remaining 30% by 2005. The chief training organisers of KVKs have always been given flexibility in identifying appropriate programmes and sources of funding beyond that provided by ICAR for the areas in which they operate. One advantage of the new funding policy is that this flexibility is reinforced: CTOs are being positively encouraged to seek long-term funding relationships with local constituencies, such as NGOs, and with international organisations. Box 3 details the range of current and planned activities of the KVK located at the Vidya Bhawan Society.

Other changes have been promoted by the ICAR Division of Agricultural Extension to encourage a participatory interaction directly between selected ICAR institutes, SAUs, KVKs, Regional/Zonal Research Stations and villages in the Institution-Village Linkage Programme (IVLP) (ICAR, 1995a). This proposal, first piloted in rabi 1995-96, was expected to cover 42,000 farmers over three seasons at 42 selected centres, with subsequent up-scaling by the National Agriculture Technology Project to some 200,000 farmers. Basically, the IVLP argues that technology integration- process or set of activities that must happen if a new information can be put to use in the farm production system- is a neglected function. In the IVLP view, this neglect accounts for the widespread failure of technologies to be taken up, especially in complex, diverse and risk-prone rainfed areas. The IVLP recommends problem-focused, systems-oriented, multi-disciplinary approaches capable of generating "baskets" of technologies that are profitable, highly sustainable, low-risk and equitable in their impact among men and women. The socio-economic impact of such technologies will be assessed, as will their capacity for scaling up to other areas. Relatively underdeveloped villages representative of a district will be selected, and participatory rural appraisal will be used to diagnose technology requirements. Teams comprising four or five of the main disciplines will be selected and trained in the necessary client-

oriented, participatory techniques of identifying needs and screening, testing and adapting technologies.

We appreciate the need for technology assessment and refinement, but have doubts on the methods to address this through the IVLP programme. Developing appropriate technologies (field-testing, adaptation and fine-tuning) are the responsibilities of all concerned with technology development, and should not be the task only of a team of scientists (the IVLP team) at the institute level. Agro-ecosystem analysis reports would become useful only if there is a willingness to redesign research based on their findings. Other than studying farmers' socio-economic conditions, farming practices, etc, which are important, social scientists should enhance their understanding of the local economy, existing production networks and system interconnections in their area. To design appropriate models of technological interventions, social scientists may have to increasingly adopt action-research strategies. The contribution of social scientists in the ICAR/SAU system in this line is at present very limited.

3.4 Strengthening the Organisation and Management of Extension

The T&V system of extension widely adopted in India was conceived over 20 years ago, at a time when the penetration of mass media outside those areas with good communications infrastructure was minimal. Not surprisingly, therefore, it relies heavily on face-to-face contact to provide both information and training. The recent growth in the availability of radio, television and video in many villages-even in rainfed farming areas-offers opportunities for new approaches. A recent publication (World Bank, 1994) summarises these opportunities, so they are not reiterated in detail here. However, a review of some aspects of how the mass media in India deals with agricultural information is presented in Box 11. Suffice it to say that:

- There are strong arguments for separating out the function of information provision from that of training: many elements of the former can be met by mass media, whereas much of the latter requires individual approaches.
- Mass media such as radio, television and video are not constrained by the levels of literacy of farmers.
- Mass media need not be top-down: innovative approaches can allow farmers to tell their own story, from which others might learn.

Much of the work programme of extension services is currently driven by targets and restricted to, for example, the varieties of crops that have been officially released. Greater flexibility is needed so that extension workers can focus more on identifying and responding to farmers' requirements. Clearer guidelines need to be designed and enforced to streamline and strengthen extension-staff training. Present arrangements allow for training to be conducted in three different types of organisation: the SAUs, the KVKs and the departments of agriculture themselves, with a resultant high risk of gaps and overlap. The curricula of training courses should be modified, to cover the complexity and diversity of rainfed farming, needs-assessment methods, the conduct of on-farm trials, the assessment of risk, the understanding of risk-averting techniques, and so on. This list is similar to that above (=> Section 2.7) for researchers. In addition, the modes of working in multi-organisational partnership in research and extension (=> Section 4.3) need to be incorporated into training programmes for extension workers at all levels. The continuation of group-based approaches to extension makes it essential for ASs to receive training in group formation, the development of leadership skills, conflict resolution and so on.

We see much of value in the diagnosis of issues facing extension in India in the draft proposals on extension being submitted to the NATP (Swanson, 1996), viz:

- The multiplicity of institutions involved in extension operates with little or no co-ordination.
- A serious institutional constraint is the lack of strong research extension linkages, particularly at the district level.
- The current technology system is strongly top-down in orientation, concentrating on the dissemination of broad-based messages, with little attention to solving problems of the farmer, particularly those of disadvantaged groups.
- Operational funds are severely limited.
- The private sector is getting stronger in some areas (particularly where commercial crops are grown), generally in the provision of advice linked to the purchase of inputs. Links between these and representatives of farmers' organisations have generated an effective and practically fully privatised technology system with little need for public-sector involvement.

- NGOs are becoming more involved (especially in the more difficult areas), and their strengths lie in community mobilisation, awareness creation and group formation.

We also endorse the objectives of the proposed extension component in the NATP and would commend them to both central and state governments, viz:

- Increasing the quality and types of technologies being disseminated by focusing on the generation of location-specific recommendations and sustainability-enhancing technologies.
- Enabling the system to become more demand-driven and responsive to farmer problems, through such devices as farmer stakeholding in a competitive-grant fund.
- Strengthening research-extension-farmer linkages, especially in feedback.
- Increasing the financial sustainability of the technology dissemination system.
- Moving towards shared ownership of the system by key stakeholders
- Phasing out the current cadre of ASs and AEOs to make room for a higher level of Farm Advisers.

Box 11 : Enhancing the role of mass media

The widening reach of mass media such as radio, television, video and print media offers good prospects for its effective utilisation in agricultural . extension.

Radio and Doordarshan. All-India Radio and Television (Doordarshan) networks have expanded considerably during the last two decades. At present there are 81 All-India Radio stations producing and broadcasting agricultural and rural programmes. All Doordarshan Kendras regularly telecast rural development programmes. The main thrust is on agriculture. For effective linkage between the ministries of agriculture and of information and broadcasting, a three-tier mechanism for media co-ordination (national, state and kendra level) has existed since 1994. A review of the rural programmes of AIR and Doordarshan by Kaurani (1995) revealed the heavy emphasis on studio-based programs in radio and television, mainly due to constraints in transport and inadequate recording equipment for preparing field-based programmes. To make the programmes interesting and useful, the emphasis should shift to field-based programmes. Kaurani suggested the following steps:

- The monthly workshops held by SAUs for training of SMSs on production recommendations specific to particular areas may be recorded for broadcast by AIR/ Doordarshan.
- Stories about project or programme successes, and cases highlighting individual farmers or groups should also be broadcast.
- The media should also cover farmers' problems and their solutions. They should also provide timely information on input availability, weather conditions, etc.

Except for E-TV in Andhra Pradesh, independent, private television channel (such as satellite and cable TV) do not promote the cause of agricultural development. E-TV broadcasts 30 minutes of agricultural programming a day.

Videocassettes. Production of videocassettes on topics related to agriculture is also on the increase. To promote the use of video in extension, the Directorate of Extension of the Ministry of Agriculture, has supplied TV sets and VCRs to different state departments of agriculture. The department of agriculture in Rajasthan has excellent facilities for video-film production. More than 30 such videos have been produced by the unit, and copies have been distributed down the line to assistant directors of agriculture for field screening. Allied departments such as soil conservation and horticulture have come forward to strengthen and access this facility by forming a consortium, the "Centre for Agricultural Communication".

However, the utilisation of these videos in field is weak. At the most the cassettes are used for training at the sub-divisional level, or at the block level for training AOs and ASs. Addition or updating of cassettes happens rarely, and repeated use of the same videos does not serve the intended purpose.

Print Media. Print media, especially the vernacular press, also contributes in a big way in disseminating agricultural information. Though poor literacy in rural area is a constraining factor, the increasing circulation of vernacular papers indicate their increasing reach in rural areas. Almost all newspapers provide at least one page every week exclusively for agricultural news and features. There has been a recent spurt in the growth of farm magazines too. Except for one magazine each published by the ICAR, the state departments of agriculture and SAUs, all the initiatives in print media are private.

Presently there is no government initiative to bring print media and the extension machinery closer. Extension wings should come out with a media plan in collaboration with mass-media representatives. This would be rewarding for both.

We also accept the recommendation that the district should become the focal point for integrating the research and extension functions and for decentralising the management of technology dissemination and related training activities.

However, we find it difficult to accept that an "umbrella agency] society" (DAS) as currently conceived would be adequate to perform the intended functions of disbursing funds to promote the adaptation and promotion of location-specific technologies through the extension system and to promote appropriate training. The reasons for our scepticism, and suggested amendments, are as follows:

- District collectors or magistrates are too busy to chair management-committee meetings and so to ensure that positive, regular exchange and interaction of the types intended actually takes place. The best that can be hoped for here is that the senior line-department officer identified to be QIC of the DAS would gain sufficient response from other line department staff to have the departments work together effectively, invoking the authority of the collector or magistrate only on rare occasions.
- The KVKs are highly variable in performance. The "institutional home" of some poses such severe structural problems that little improvement in performance will be possible unless they are relocated. Prior to their blanket incorporation into the NATP, a comprehensive review of KVKs is necessary. This would examine: (i) their performance in technology testing, dissemination and training; (ii) their complement of staff, and how far they have been able to generate external funds, or raise funds from the sale of services or products; (iii) how far any deficiencies in performance are related to their institutional home.
- Staff-performance criteria and assessments in both extension and research services still only weakly reflect clients' preferences. It is unrealistic to expect staff to make client-responsiveness their top priority without thorough reforms in this area.
- Farmers' groups are currently weak or non-existent, especially among the weaker sections in difficult areas. To support and strengthen them requires the services over a long period of trained facilitators from suitably oriented organisations, such as
- NGOs. Certainly, the record of agriculture-department staff in supporting group formation under the "modified" T&V system has not been strong.
- There is no mention in the proposals of a role for the panchayats, nor for elected representatives at any other level. Whilst such involvement might in some contexts be disruptive or simply ineffective, in others it may give a powerful stake to elected representatives who, in turn, may be able to exert an influence from outside the administration on the performance of line departments. In some circumstances, this may be more effective than trying to reform the departments from within. The NATP proposals could usefully be structured to permit this possibility where relevant.

The above draft proposals for incorporation into NATP have much to commend them, and with the additional safeguards outlined, merit implementation on a pilot basis.

However, the potential difficulties of implementing this approach suggest that alternative, innovative approaches, incorporating many of the same principles might be used where feasible. In Section 5 we discuss, for instance, how agencies responsible for implementing the rehabilitation of micro-watersheds in rainfed areas might draw down relevant services from line departments.

4. ENHANCING FARM-LEVEL TECHNOLOGY THROUGH STRONGER RESEARCH-EXTENSION LINKAGES

4.1 Current Linkage Arrangements

Much of the formalised structure of research-extension linkages is evident in what has been described above. For instance:

- ICAR institutes and programmes are intended to conduct predominantly basic and strategic research. Its results may be tested on a small scale through their own technology-transfer units and regional stations. They may also be demonstrated and I tested via the KVKs, which in turn provide information to allow refinement of the technology. Overall, the results of ICAR research are intended mainly to be conveyed to SAUs for further applied and adaptive work, both in their main campuses and in zonal and other regional research stations. Again, the KVKs may have a role in testing the results of this work and in making recommendations for refinement. These results subsequently form the basis for extension recommendations to be formulated by the state departments of agriculture and for state-level schemes for large-scale demonstrations and provision of inputs (in some cases, at subsidised rates).
- Further linkages are provided via the arrangements for training at various levels: for instance, DoA cadres can be provided with in-service training, but can also be trained at the SAUs and at KVKs.
- A third formal channel for linkages is via the provision of foundation seed of new varieties to the state and national seed corporations. These then make the technology available to farmers. An analogous transfer occurs from researchers concerned with new equipment. For equipment, there is increasing financial pressure on ICAR institutes to make this available via the private, commercial sector and to earn licence or royalty fees in the process. Our view is that the transfer of new technology via improved inputs has been comparatively neglected in recent debates on research-extension linkages. We therefore treat it separately below (=> Section 6).

In general terms, those states adopting T&V have in varying degrees accepted World Bank advice, to the effect that extension agents should no longer have responsibility for input supply. Some direct responsibility is retained in some circumstances where, for instance, subsidies are provided, as in Rajasthan with sprinkler-irrigation equipment. Also, the extension services play a key role in indenting provisions of seeds from the state and national seed corporations.

There is growing pressure to strengthen linkages and to design pathways for the uptake of new technology according to the characteristics of particular cases. An "if when" analysis of the kind (Table 7) provides a number of insights into how this might be done.

4.2 Research-Extension Linkages and the Role of the Private Sector

The Johl Committee envisaged a closer relationship with the private, commercial sector and its practices in two broad ways. First, through contractual partnerships in which, for instance, the private sector would commission research or pay royalties for access to technologies developed by the public sector. Insofar as market forces help to signal farmers' requirements for new inputs, and commercial companies respond to these, a public/private partnership may be expected to enhance the overall efficiency of the technology system, and generating resources for the public sector. Second, and less directly, the public sector was expected to introduce certain practices normally associated with the private sector, such as entering competitive bidding for research-grant funds, charging for certain services, and earning a portion of its own revenue. Whilst views formulated in such international organisations as the World Bank on the respective roles of public and private sectors in relation to research and extension have now become part of neo-liberal economic orthodoxy, they have not yet become common currency within the ICAR or SAU systems. It would, in any case, require much patient work for them to become established. The long tradition of direct state involvement in the economic affairs of India has been justified partly in terms of the need to protect the public from the exploitation by the commercial sector.

Table 7 : Characteristics of users and the implications for planning dissemination

If:	Then :
A high proportion of users are not aware of a need for the output	• Check its relevance against technical and socio-economic criteria • Include awareness-raising as an objective in dissemination • Hold workshops for intermediate users Use mass media for end users
Outputs will be particularly significant to a small number of intermediate users, whose work influences large number of other users	• Involve key scientists in the research • Hold workshops
Users have access to e-mail	• Set up e-mail or discussion group early in the research process
Using the output requires new cognitive or physical skills	• Identify training and extension institutions for dissemination • Run or commission training-of-trainers events for these institutions • Provide training-support materials
The output will require local adaptation	• Identify institutions which can undertake, with users, adaptive testing and research (for example NGOs, government extensions services) • Commission a video to promote the output and 1 show how a process of local adaptation can work • Build adaptive phase into the research, or 1 propose further research to test adaptation 1 processes using FPR methods I
Uptake by end users requires capital outlay	• Provide information to formal credit institutions • Identify agencies able to provide micro-finance, ' and provide information !
Uptake by end users requires collective decisions and /or action	• Liaise with agencies working with local groups of users • Build testing of a model of field application into the research process • Propose inclusion of dissemination or promotion in bilateral projects
Output is no or low cost for end users and is easily assimilated into farming systems	• Consider mass media, particularly radio
Output is embodied in material inputs	• Provide input suppliers with point-of-sale posters and leaflets • Provide or commission dealer training
Output involves use of decision tools in the field	• Produce pocket guides • Develop trainers' materials for use by intermediate agencies to train extension personnel in how to use the tools and in how to train end users.
Output is widely applicable to end users in several countries	• Provide information to media agencies who make programme content available to broadcasting organisations

Source: Garforth, C. Reading University, U.K. Personal Communication

Unsurprisingly, this is widely reflected in the prevalent view in the ICAR that one of its important roles is to protect farmers from exploitation (This view was expressed to the team by a number of the ICAR directors interviewed, and by the vice-chancellor of an SAU.)

Considerable tensions therefore arise between traditional views, of the role of the public sector, and the new directions being mapped out for the ICAR. Some senior professors have strong personal views on respective roles in some areas. Many argue that the public sector should concentrate on breeding varieties, leaving the private sector to concentrate on hybrids.

However, few are willing to remain entirely "hands off' in respect of the private sector. This may be on purely commercial grounds, as when, the ANGRAU persuaded a state corporation to import and sell cauliflower seed at Rs 5,0007kg to counteract private company imports selling at Rs 30,000/kg. In other cases, it may be generated by an increased awareness of the need to ensure fair play in public/private interactions. In 1994, the ANGRAU made the parental lines of some crops available to the private sector free of charge, but was then disturbed to note the substantial profits being made from the resultant hybrids. In some cases, the private sector claimed that it has produced parental lines of hybrids when, in reality, it acquired these lines from the public sector. In such cases only DMA fingerprinting can identify their origins with certainty.

In many other cases, however, relations with the private sector have been routine and satisfactory; the ANGRAU has released 243 varieties of different crops, 75-80% of which are in active cultivation in Andhra Pradesh and elsewhere (A percentage much higher than that noted earlier for Rajasthan, Gujarat and Madhya Pradesh.). Approximately 60% of breeders' seed goes to government seed-corporations, and the remainder to private companies, though there are wide variations among crops. Many regard the private sector as the engine of technological change in some crops, e.g. maize is a minor crop in Andhra Pradesh, but there has been a very substantial increase in its yield per hectare around the main cities, principally due to the market for roasted green maize sold on the streets. Private commercial seed companies are the main seed suppliers. Maize is also a staple food in tribal areas, but hybrids have not so far been taken up in these areas, and public-sector varieties have gained little acceptance, so yields have stagnated.

On the other hand, many are concerned over the implications for intellectual property rights of an expanded private-sector role some private-sector organisations in Andhra Pradesh are claiming that farmers are "poaching" seed by passing the next generation on to their friends.

4.3 Strengthening Research-Extension Linkages

Implementation of the above recommendations for strengthening rainfed research (=> Section 2.7) and extension (=> Section 3.4) will strengthen the client-orientation of both, create space for demand to drive the agenda, and so stimulate both existing and new linkages between research and extension.

The public sector must recognise that it faces chronic problems in the provision of extension services to many rainfed areas, given the rapid turnover of extension staff and the high proportion of vacant posts at any one time. But recognising this generates scope for reform, specifically in research-extension linkages in two related areas:

- First, widespread institutional recognition needs to be gained within the public sector of the advantages that multi-agency partnerships with, for instance, NGOs and farmers organisations, will generate (such as more direct access to farmers' needs; and access to NGOs' needs-assessment and group-formation skills). Modes of working with NGOs and farmer groups then need to be introduced into the work norms of the various levels of the extension services. These may range from contracts of fairly limited scope which simply require NGOs to deliver extension services in specified areas, to much wider collaboration, where both parties have an equal say in the design of programmes and are jointly responsible for achieving the agreed outputs and purpose.
- Second, a positive response to, and further encouragement of, the various types of para-extension worker proposals that are currently emerging. These would either work alongside ASs or, in areas where AS posts are chronically vacant, act instead of ASs. There would be justification for diverting to them some of the public-sector resources saved as a consequence of the high proportion of vacant posts. In addition, the public sector would be well advised to permit PEWs to establish wide-ranging links at higher levels of the extension hierarchy, drawing on the

specialist knowledge of AAOs and SMSs where necessary. This arrangement would have the twin advantages of allowing SMSs and AAOs to become familiar with farmers' needs at first hand, and so pass them on more readily to the research service's, and of removing from ASs the burden (which to many appears unrealistic) of becoming "broad-based".

There are, however, specific institutional and political factors underlying the current pattern of research-extension linkages that need to be taken into account in any proposed changes. The first is that the substantive interaction between states and the centre on research is limited, so that gaps and overlaps are created. Furthermore, where there is substantive interaction, this can be marked by potential tension. This tension is-as it was no doubt intended to be-at times healthy. At other times it is less so. The fact that the responsibility for basic and strategic agricultural research lies mainly with the centre, whereas applied, adapted research and extension is principally a state subject, allows political factors to cut squarely across research-extension linkages. A further set of political factors is at work: to protect and enhance its reputation, ICAR seeks to present evidence that its technologies are working in the field. Given the potential tensions between states and centre, it would not be unreasonable for ICAR to regard the states as unreliable channels for the uptake, adaptation and implementation of technologies. It would be far easier for ICAR to develop channels of its own that would allow its institutes to demonstrate to influential stakeholders, that farmers (it matters less how few) are willing to take up the technologies on offer.

Some would therefore argue that the "first-line extension" projects or programmes (Operational Research, National Demonstration and Lab-to-Land), and the KVKs in which they were eventually located, all have a political significance to ICAR at least as important as their ostensible agricultural purpose. The very recent IVLP clearly falls into the same category: seen in this way, the fact that it has no clearly demonstrated multiplier effect is of little importance. Of far greater importance is the evidence it provides of direct concern by ICAR scientists for a number of "adopted" villages. The changing pattern of ICAR fund allocations provides perhaps the conclusive evidence of a widening gulf between states and centre. ICAR Plan funding for extension activities under its own control (ie, the KVKs, IVLP and projects and programmes outlined here) has increased from 4.4% of all funding under the Sixth Plan to over 12% in the Eighth Plan. Over the same period, its allocation to agricultural education, which is largely in the hands of the SAUs, has diminished from 21.7% to 11.9% (Table 8).

There is little to suggest a slowing or reversal in the growing importance of this political division. Calls for closer formalised links between basic/strategic research conducted in ICAR and applied/adaptive research and extension performed by the states are therefore likely to generate little response. The hopes for improved interaction between states and centre in this context are threefold:

1. A slimming-down and re-invigoration of the AICRPs (as proposed by the ICAR Review Committee on AICRPs) may generate technologies of interest to the states, which they can then adapt and feed into their own extension services.
2. A tightening of organisation and management in the SAUs will require all research proposals to take account of all other recently completed or on-going research, including that of the ICAR institutes, so that the prospects of one drawing upon the other might be increased.
3. An improved bibliographic and project-management system will provide databases on which the SAUs can draw as their research proposals are being prepared.

Table 8 :
Budget allocations under ICAR Plans by activity and commodity (Rs million)

Plan	IV (1969-74)	V (1974-78)	VI (1980-85)	VII (1985-90)	VIII (1992-97)
Research					
Crops	200 (21.9)	319 (20.8)	698 (20.5)	904 (21.3)	3228 (24.8)
Horticulture	74 (8.1)	93 (6.1)	222 (6.5)	237 (5.6)	1000 (7.7)
Animal Science	152 (16.6)	259 (16.9)	356 (10.5)	446 (10.5)	1400 (10.8)
Fisheries	34 (3.7)	81 (5.3)	178 (5.2)	188 (4.4)	650 (5.0)
Other	119 (13.0)	179 (11.7)	1042 (30.6)	1396 (32.8)	3233 (24.9)
Total research	**579 (63.3)**	**932 (60.7)**	**2497 (73.4)**	**3172 (74.6)**	**9512 (73.2)**
Education	316 (34.6)	525 (34.2)	739 (21.7)	708 (16.7)	1554 (12.0)
Extension	18 (2.0)	71 (4.6)	149 (4.4)	321 (7.6)	1600 (12.3)
Other	1 (0.1)	7 (0.5)	14 (0.4)	49 (1.2)	334 (2.6)
Overall total	**914 (100)**	**1535 (100)**	**3400 (100)**	**4250 (100)**	**13000 (100)**

Note : Figure in parentheses are percentage of total outlays
Source : Jha et al. (1995)

5. ENHANCING TECHNOLOGY SUPPORT FOR REHABILITATED MICRO-WATERSHEDS

Micro-watershed rehabilitation (MWR) has been a major plank of agricultural and rural development in rainfed areas under the Eighth Plan and is likely to remain so in the Ninth Plan period. Some 170 million ha in India are classified as degraded. Currently, three central-government ministries are involved in MWR-Agriculture and Co-operation, Rural Areas and Employment, and Environment and Forests-in addition to numerous state-level agencies. Public-sector expenditure on MWR approaches US$200 million per year, with approximately a further US$60 per year provided by foreign assistance from various sources. MWR has important agricultural implications:

- Soil and water runoff is reduced, and water percolation improved, through both revegetation and the construction of physical structures on the upper slopes.
- This has the direct effect of increasing the volume (at times also the quality) of available fodder. This, together with the need for restrictions (possibly a ban) on grazing, opens opportunities for new management practices and encourages the genetic upgrading of livestock.
- Increased percolation raises water tables, increasing the amount of water which can be lifted for irrigation, and having one or more positive effects on agriculture: (i) the possibility of irrigating during the season and so reducing the risk of crop failure through drought. In turn, this might stimulate increased investment in yield-enhancing inputs such as agro-chemicals; (ii) the possibility of extending the seasons, and introducing longer-duration and therefore higher-yielding varieties; and (iii) the possibility of cultivating for a second season.

Three general attributes of watershed rehabilitation with implications for the organisation and focus of research and extension are clear:

1. Micro-watershed rehabilitation can raise agricultural production through combinations of (i)-(ii') above. To take full advantage of these possibilities requires technologies that are likely to be unfamiliar to farmers, and so provides a major opportunity for research and extension services to provide these from outside.
2. Watersheds represent natural resource systems, and approaches to technical change should ideally be systems-based. As a very minimum, what is recommended by animal-production specialists should take advantage of changes that are occurring in crop production, and vice-versa.
3. If certain important dimensions of technical change in micro-watersheds are to be understood properly, following social-science skills must be brought to bear:

- Analysis of risk-avoiding practices by farmers and those (often functionally landless) who depend on common-pool resources for their livelihoods. New technologies are not likely to be acceptable if they are not consistent with farmers' treatment of risk.
- The understanding of institutional issues as they relate to sustainability. Much of the management of common-pool resources depends on joint action by villagers, and on setting up and maintaining village-based institutions to agree on access to the resources, penalise unauthorised access, and manage common-pool and other resources used in agriculture-such as water for irrigation. For instance, regulations over the use of deep wells (if they are to be permitted at all) and over the types of crops that can be . grown (it may, be decided to ban crops with heavy water requirements such as rice or sugarcane) should be made jointly. Tubewells and water-demanding crops, if unregulated, are technologies that wealthier individuals will dominate, with adverse distributional effects within the community.
- The understanding of equity and distributional issues. Enhanced production alone is rarely a sufficient development goal. It may be economically sub-optimal in a Pareto sense, and socially undesirable, to allow its benefits to be concentrated in few hands-

and this will undoubtedly be the result of laisser-faire strategies. There are numerous areas where undesirable equity effects may occur. Some are highlighted above; several others relate to changes in the livestock economy and related areas such as fodder supply. For instance, a "closed" period necessary for rehabilitation of common-pool resources may temporarily deprive the landless of an income source; changes in livestock-management practices will affect their employment opportunities; the higher value of common-pool resources may prompt attempts by the wealthier to take over access opportunities to them. In all of these cases, social-science skills are needed to guide technical change in directions that not only enhance productivity but do so in ways that are distributionally acceptable and institutionally sustainable.

Experience from a number of watershed-rehabilitation projects (see Farrington and Lobo (1997) on the Indo-German Watershed Development Programme in Maharashtra) suggests that the following are prerequisites if MWR agencies are to be strong enough to draw in research and extension services to provide new technology for rehabilitated watersheds:

- Funds under their control must be sufficient to cover, as a minimum, the operational costs incurred in developing, adapting, testing and disseminating the technology.
- Professional expertise in the MWR agency or support organisations must be sufficient to specify the technical problems and opportunities in sufficient detail for them to be meaningful to external experts, to discuss and agree with them the detail of their proposals, to monitor work, assess the results, and decide upon any follow-up research or dissemination. If implementing or support organisations do not have sufficient capacity of their own in this regard, then they should have the resources to contract independent advice.
- A capacity for participatory on-farm testing of the technology options generated through research is also highly desirable, so that farmers' opinions can be fed back to the research system without delay.

However, these conditions are not in themselves sufficient for efficient technical change, e.g., if research staff have no incentive to obtain self-earned funds (and can get away with not doing so), then they are unlikely to respond to the availability of funds. Policy decisions have been taken such that the ICAR institutes and KVKs are now obliged to move in this direction. Other research (and eventually, extension organisations) should now move in the same direction. Time will tell whether systems for assessing staff performance and enforcing such criteria can be implemented.

6. ENHANCING FARM-LEVEL SPREAD OF TECHNOLOGY EMBEDDED IN INPUT SUPPLY: THE EXAMPLE OF SEED PROVISION

This section (This section draws heavily on Witcombe ef al (eds) (1998); Tripp (1995) and Tripp(1997).) argues that there are strong, but as yet only partly exploited, possibilities for enhancing farm-level technology through improved provision of the genetic resources used by farmers. The argument is divided into two parts: first, we consider how procedures for varietal testing and release might be improved and, relatedly, how plant-breeding priorities might be made more client-oriented. Second, we examine ways of improving seed supply itself. This analysis is of particular relevance to rainfed areas for three reasons: (i) rainfed farmers' criteria for varietal selection go beyond grain yield, and need to be taken into account; (ii) conditions in formal trials can differ widely from those in farmers' fields, and this gap needs to be narrowed; and (iii) the wide diversity of agro-ecological conditions means that the exchange of information and materials among breeders must be as efficient as possible if gaps and overlaps in breeding efforts are to be minimised.

6.1 Plant Breeding and Varietal Release

A wide selection of desirable characteristics can be transferred through seed, ranging from fertiliser responsiveness to tolerance of adverse conditions such as salinity, or avoidance of others like drought. This section argues that there is a strong relationship between regulations and procedures governing varietal release on the one hand, and practices and guidelines for plant breeding and varietal selection on the other. In turn, these practices and guidelines have knock-on effects on the types of varieties made available to farmers and the technologies they incorporate. The crux of the argument is that to make regulatory frameworks governing release more "user friendly" enhances the prospects of producing varieties more relevant to farmers' needs. It also therefore enhances the uptake of new technology embodied in these inputs.

In addition to facilitating improvement in linkages, any improvements in the system of plant breeding and release will generate major efficiency gains: the AICCIPs alone in 1992 operated for 19 crops or groups of crops, and occupied 1,750 scientists at 380 centres with a budget of Rs 178 million.

Regulatory frameworks governing release of new varieties have evolved over almost 100 years in the USA and many European countries, usually with significant participation from the private and public seed sector, and from farmers. In many settings it has been the private sector that has taken the lead in establishing independent regulatory mechanisms to protect the seed industry's reputation. By contrast, in many developing countries (India included), regulatory frameworks have been introduced from industrialised countries, adapted to suit the needs of government agencies (in the absence of a strong private sector), and then rarely altered in any substantive way.

Witcombe et al. (1998) conducted a major review of the implications in India of the Seeds Act of 1966 (amended in 1972) and of the Seeds Rules of 1968 (amended in 1973, 1974 and 1981). This review was based on a detailed analysis of breeding and release in three states where rainfed agriculture predominates (Gujarat, Rajasthan and Madhya Pradesh), and of AICCIP records. The review argues that regulatory frameworks exhibit characteristics that have worked to the disadvantage of low-resource farmers. These include:

- The inadequate adaptation of regulatory frameworks to local agro-ecological and socio-economic settings following their introduction from other countries.
- Standards of varietal uniformity and seed purity which are more stringent than is practically useful, and so have discouraged adaptation to suit local circumstances. In addition, stakeholder groups such as low-income farmers, or (until recently) the

private, commercial sector, have rarely been consulted over the appropriateness of existing standards, regulations and guidelines.

- An intention to protect farmers, which, if too rigorously implemented, can severely restrict the range of new genetic material reaching them. Much evidence now suggests that farmers do experiment with new material on a small scale (to minimise the risks of failure). However, if plant breeders perceive the release regulations as a series of hurdles which their material must overcome, then they are bound to be conservative in the range of material they submit, thereby restricting the basket of choices available to farmers.
- Mismatch in many cases between the conditions under which material is selected or bred (ie, on research stations) and those under which farmers operate, leading to excessively high recommendations for agrochemical inputs. For instance, in pearl millet, yields in the AICCIP trials were 2.5 times the average yields obtained by farmers in the same districts. In sorghum, they were 2.7 times higher.

Empirical evidence (Witcombe et al., 1998) suggests a number of challenges and opportunities in relation to varietal release and popularisation:

- A high proportion of released varieties have not been grown at all by farmers, since they do not meet their requirements. In Gujarat, Madhya Pradesh and Rajasthan combined, this applies to 30-50% of all released varieties of rice, wheat, maize, pearl millet, chickpea, groundnut and sorghum.
- A number of incompatibilities exist between state and central systems of release.
- Centrally released varieties are often not accepted or promoted at the state level.
- Varieties released in one state have to pass through extensive further testing before they can be released in others.
- The state seed-subcommittees have no power to notify a variety for certification: this has to be done at central level, but only after a further one year's testing in the AICCIP.
- Government support in the form of, e,g, seed multiplication, by national or state seed-corporations, and special schemes and subsidies are provided only for officially released varieties

The principal difficulties posed for plant breeding and varietal testing by existing regulatory frameworks fall into two main groups:

1. The poor correspondence between trial sites and major areas of cultivation of the crops, and low representation of trial sites in some agro-ecological zones; and management practices in trials which do not reflect those of the majority of farmers.

   This set of problems can be addressed by a strategy of locating more trials on farmers' fields. In-this way, the number of trials could be increased at relatively low cost, covering more agro-ecological zones and using management levels that correspond with farmers' own practices. Data from the trials then need to be entered onto a computerised database allowing access by other states having comparable agro-ecological conditions.

2. The selection strategy used in the AICCIP to promote entries from one trial stage to the next relied heavily on yield. A high proportion of entries are screened out in years 1 and 2 because they do not meet stringent yield requirements. Many of these have characteristics that farmers in low-rainfall conditions may value, such as early maturation. However, whatever their other desirable characteristics, they are screened out if they do not yield well in the first two years of trials. In addition, because of the all-India nature of the trials, specifically adapted varieties that yield well only in a few locations and poorly in others will be eliminated from the trials.

This set of problems can be addressed by selecting from year 1 on the basis of a composite index including, for instance, grain yield, fodder yield, early maturity and disease resistance.

Trials in farmers' fields would allow farmers' opinions to be added to the evaluation of these and of many other traits which are otherwise difficult to assess, such as ease of de-husking, ease of processing and cooking, taste and so on. In addition, there are numerous technical measures that can be taken to improve the efficiency of trial design over the three-year period, including a greater use of unreplicated or low-replicate trials in the first year, and a greater number of sites in the final year to help to equalise resource allocation across the three years.

6.2 Providing More and More Appropriate Seed

In the previous section we argued that existing regulatory frameworks excessively restrict the types of variety produced by the plant-breeding system and require reform. This section addresses the next question: how would farmers access seed of this wider range of varieties?

In principle, the procedure for popularisation of new varieties once officially released is as follows. A "package of practices", including the relevant production and protection technology is prepared and used as the basis for popularisation by (in the case of state-released varieties) the directorates of extension education of the SAUs, in collaboration with the departments of agriculture. Education and exposure is given to extension workers and farmers through brochures, demonstrations, training camps, visits to trials and farmers' fairs (kisan melas). KVKs are also supposed to demonstrate new varieties, conduct front-line demonstrations on farmers' fields, provide small quantities of seed, and provide feedback to scientists to allow refinement of the technology. SAD and DoA staff are supposed to meet twice yearly to exchange information on new varieties and their respective recommendations.

In practice, information spreads very slowly to farmers for a number of reasons:

- Information about the release of new varieties is often not available in the annual AICCIP reports. Even breeders and other crop scientists may not quickly become aware of new varieties and their characteristics.
- The proceedings of the central variety-release committee are not widely circulated and do not reach the middle or lower rungs of the extension services or seed sector.
- The handbooks of cultivars are not updated regularly enough and do not contain full descriptions of the varieties. In particular, the recent "national catalogue" has no description of varieties at all. Again, these are not widely distributed.
- The SAUs, KVKs and DoAs confine their activities to a restricted set of recommended varieties and rarely try newly release cultivars from outside the state.

In the three states investigated by Witcombe et al. (1998), farmers did not begin to cultivate new varieties until 4-6 years after their release. As a consequence of this and of the limited relevance of new varieties produced by the plant-breeding system, the average age of varieties being grown by smallholders is very high, averaging 27 years for maize and 26 years for chickpea. No crop other than pearl millet has an average age of less than 10 years.

Under the T&V system, extension services have been widely delinked from the provision of seed. However, seed is still provided in small quantities (eg, mini-kits) by parts of the extension service to popularise new varieties, and extension services in some areas still have a role in placing advance orders for certified seed and delivering it to farmers, as is explained below.

The current release system contains major inefficiencies. Varieties released in one state cannot generally be released in another without a three-year testing programme, even though the agro-ecological zones may be identical. State-level releases, even when tested extensively within the state, have to pass through the central system. State releases have to pass through a number of committees, the preliminary committees being dominated by the SAU. There is very rarely any private commercial, NGO, or farmer representation on these committees. Private sector varieties can be released either at state or central level. In either case, they have to go through several years of testing prior to official release.

Once a variety is approved for release, breeders' seed is supplied to national or state seed-corporations or to the State Farms Corporation of India for multiplication. This is then further passed on either as "certified seed" directly for cultivation by farmers, or is passed on as "foundation seed" for further multiplication by selected growers prior to certification and distribution. The system involves a number of risks: requests (from, the extension services) for several tonnes of seed of a new variety are at times over-optimistic, and seed producers may be left with unsold stock. This encourages risk-avoiding behaviour, for instance, extension services and seed companies tend to base their estimates on current seed use-levels. Inevitably, this relies on existing, not new, varieties, and is a major contributing factor to the slow spread of new varieties.

It is difficult to get a new variety released. The seed must attain high purity standards to become recognised as "certified seed" (which in turn means that it must be sold at a high price to cover the costs of going through this procedure, and significant amounts of even slightly sub-standard seed may have to be discarded). These difficulties have led to a growing trend among private seeds companies to sell their seed as "truthfully labelled", which needs neither to be officially released, nor to meet seed-certification standards. In this way, as over many decades in Europe and the USA, companies survive or fall on the basis of the reputation gained by their brand names and by the company as a whole. Discussions with the director of the National Seeds Project in Hyderabad confirmed that many farmers are turning to "truthfully labelled" seed.

For similar reasons, NGOs have begun to explore new roles in local-level seed provision. Sodhi et al. (1998) argue that "typically, resource-poor farmers do not have access to seed of appropriate varieties, and that to make this provision is perhaps one of the easier tasks an NGO committed to development can make". The survey of NGOs' activities in seed supply reported by Sodhi et al. reveals, however, that with few exceptions, NGOs have been handling only officially released varieties because of the subsidies that they attract. A new approach promoted by the UK-supported Western Indian Rainfed Farming Project, managed by KRIBHCO, relies on networking among technical agencies (in this case KRIBHCO) and NGOs. It argues that only a few agencies need to conduct farm-level needs diagnosis and varietal trials. On the basis of farmers' responses, the adopted material can then be made available to NGOs working in similar agro-ecological conditions. In many cases, varieties adopted in this way were neither released within the state, nor included within the approved "package of practices", and so do not qualify for subsidy. The NGOs' strength is that they can bring to farmers those varieties that meet their needs, even if they are not officially released.

Several alternative methods of producing seed on a local basis to meet these demands have been tried in the UK-supported project, each responding to particular sets of circumstances. They include:

- Village-level seed banking, in which farmers pay back at the end of the season twice the quantity of seed they received at the beginning. However, this method poses major difficulties of organisation generally, and of seed quality control in particular.
- Village-level seed-producer groups have been established to produce seed of required varieties directly for sale.
- Other approaches used included the involvement of individual contract growers, the introduction of bulk seed from sources outside the state, and the involvement of private, commercial companies.

They also include a variety of "seed village" programmes now being tried (=> Box 12).

Box 12 : Concept of a "Seed village"

Numerous concepts of a "seed village" are currently being tried in India in an attempt to improve seed supply to small farmers. At the simplest extreme, the Andhra Pradesh State Seeds Corporation acquired over 200,000 quintals of seed in 1995 from villages in its Seed Village programme (Box 13).

A more complex example in Andhra Pradesh involved collaboration between farmers, the KVK located at Gaddipalli, MANAGE and ANGRAU. This took advantage of rice hybrids produced by APAU, the parental lines of which were provided to farmers via the KVK. Together with MANAGE, the KVK developed a programme for training farmers to cross the parent lines and produce the hybrids for themselves.

MANAGE's approach is largely commercially based : initially it took a batch of farmers to see the production of hybrid-rice seed, trained those expressing interest who can afford to pay for a course, and these then train further farmers. Some of these in turn become trainers, so that lateral spread is achieved in typical farmer-to-framer mode. MANAGE suggests that what facilitating organisations need is not technical skill, but, in the first instance, skill to recognise local success stories and to get other farmers to visit them, so that a demand for training and resources is generated within the farming community.

MANAGE funded the infrastructure for training at the Gaddipalli KVK so that innovative approaches to hands-on training in hybrid-seed production could be introduced : training-cum-production and training-cum-extension via distance learning. Scientists provided the initial guidelines, but 50% of these have been rewritten due to farmers' comments. Central to MANAGE's philosophy is that training can be used as an effective platform for research-extension-farmer linkages.

6.3 Opportunities for Enhancing Farm-Level Technology through More Efficient Seed Provision

The opportunities in this area are many, of considerable economic potential, and ripe for exploitation. Several opportunities suggest themselves immediately from the above discussion (However, for a more technical discussion of the opportunities for reform of plant breeding procedures, see Witcombe et al. (1998))

- A comprehensive and regularly updated computerised database of the characteristics (and sources of seed) of released varieties is needed. This information is supposed already to be in the public domain, but is difficult for even the most dedicated plant breeder to access, so the inefficiencies of gaps or duplication are bound to continue.

Plant breeders drawing on such a database could quickly identify varieties potentially suitable for the concerned areas. Once identified, these ought to pass through much more relaxed procedures than currently predominate for release in states other than those where they were bred.

- Such relaxed procedures ought also to apply to materials introduced by the private or voluntary sector. Their views on possible improvements in the release and certification procedures need to be taken more fully into account than hitherto.
- The conduct of a high proportion of on-farm trials in plant breeding or varietal selection will close the gap between what breeders produce and what farmers want, as also will a set of* criteria for testing and release which include fodder value,

cooking and processing quality of grain, etc. and so reflect more closely farmers' own criteria.

- In semi-arid areas, farmers have a range of practices that help avoid the risk of drought. These need to be studied and incorporated into breeding and selection procedures.
- Public-sector seed provision is often inefficient. Neo-liberal perspectives of the kind currently espoused by international agencies suggest that the state should act more as a regulator and facilitator of productive activity rather than continue to beengaged itself. However, where markets function poorly, as in many rainfed areas of India, there remain strong arguments for a continuing involvement of the public sector in this role. Certainly, as the example of the Andhra Pradesh State Seeds Corporation indicates, efficiency levels can be improved enormously (=> Box 13).
- However, low-resource farmers operating in semi-arid conditions remain poorly served by both public and private sectors in this area. Efficiency and equity considerations suggest that a wide range of seed-supply options should be considered, including those involving the NGOs and farmers' groups. Experimentation with these, and exchange of information on what works and under what conditions, is now an important priority.
- There is evidence that official standards of seed certification generate a product that is unaffordable for many low-resource farmers. Many private companies favour a system of truthful labelling, and it is likely that, if they are to become more strongly involved, NGOs and farmers' organisations would too. There are strong arguments to suggest that, once trueness to type is established, quality control will be self-regulating: those organisations marketing sub-standard seed will rapidly lose market share. For all of these reasons, it would be desirable for government to facilitate wider truthful labelling than is currently the norm, and to monitor the outcomes closely.

All in all, there are potentially extremely important opportunities for technology diffusion through seed systems. These are in many ways easier to improve than are systems of information provision through, for instance, research-extension links. There are good arguments for early and thoroughgoing review of the improvements that can be made in varietal release, plant breeding and seed-supply systems.

Box 13 : Exceptional dynamism in a state seed-corporation : The Andhra Pradesh State Seeds Development Corporation

APSSDC was established in 1976 and now produces 600,000 quintals of seed, compared with an initial 25,000 quintals. It also exports seed to Maharashtra, Orissa, Karnataka, Madhya Pradesh, Rajasthan and West Bengal.

Seed requirements are assessed from information provided through DoA field staff. Some information on likely demand is also gathered by SSDC participation in the ZREAC meetings of the seven zonal stations in Andhra Pradesh. Breeders seed obtained from the ICAR or ANGRAU is then multiplied on the three farms owned by SSDC, and also on the farms of the 7,000 shareholders in the corporation. One-third of the shares in SSDC is held by GoAP, one-third by the National Seeds Corp, and one-third by the 7000 shareholders/seed growers. Following the removal of responsibility for input distribution from DoA, seed was distributed on credit via SSDC-appointed dealers in each district. Many did not repay the credit, resulting in huge losses.

The SSDC's new strategy is to operate on a "cash and carry" basis via 84 outlets of its own throughout Andhra Pradesh. This strategy has proved accessible to farmers and has been financially successful for SSDC.

SSDC has traditionally dealt only with varieties, but is now planning to market hybrids of, for example, maize and sunflower obtained from abroad, since none are obtainable from the public sector. SSDC has also entered breeders'-seed production to a limited extent, and is multiplying up the parental lines of newly-released hybrids of bajra and of rice.

SSDC continues to receive a subsidy of Rs 2-4 per kilogram of seed, but is now in a financial position to manage without the subsidy. SSDC has managed to reach a financially viable position, despite the volatility of the seed market (farmers' final choice of variety may be determined by weather conditions at the beginning of the season).

SSDC has found the quality (purity) of breeders seed supplied by government organisations at times unsatisfactory. Partly for this reason, it is thinking of setting up its own research-and-development facility.

The success of SSDC under its new commercial-mindedness has implications for government services. For instance, ICAR and the SAUs may find it more difficult to get their varieties multiplied up by the SSDC if it is bringing varieties or hybrids from abroad-or even from other states-yet this latter policy may ultimately be in the interests of the farmer.

7. IMPLEMENTATION STRATEGY

Some of the recommendations in this paper can be implemented fairly simply on a "free-standing" basis; the implementation of others requires systemic changes within various organisations engaged in research and extension. The first, and most fundamental point, is that systemic changes will not take place unless they are seen to have full support from the highest level. A second point is that if change is to be implemented sustainably, then written directives or orders have to be supplemented by changes in perspectives and enhancement of capacity among the heads of various institutions and departments. The purpose of Table 9 is to set out how the latter can best be addressed.

Table 9 : Strategies proposed for implementing reforms

1. Strengthen the role and contribution of social sciences in agricultural research institutions

Proposed mode of implementation:

- Increase allocation for social sciences in ICAR from 0.7% to 5% over a 5-year period.
- Expand social-science positions in the ICAR/SAU system.
- Promote regular interaction among social scientists to promote cross learning (NCAP may take the lead in this).

2. Promote client-orientation and stakeholder involvement in research priority-setting, planning and implementation

Proposed mode of implementation:

- Incorporate technical presentations on these themes in the ICAR directors' meetings and vice-chancellors' conferences.
- Increase the self-earning requirements of research institutes and universities.
- Increase the proportion of research conducted under contract funding.
- Improve scientists' skills in various areas to promote client-orientation and understanding of rainfed farming. (Also see the section on human-resource development.)
- Implement merit-based promotion and redefine staff-appraisal and performance criteria to reflect client-orientation more strongly.

3. Develop human resources

Improve scientists' skills in the following areas:

- Needs-assessment techniques (such as participatory rural appraisal).
- Understanding of farmers' risk-averting practices and their implications for the design of research programmes and formulation of recommendations.
- Modes of working in multi-organisation partnership with research and extension agencies within and outside the public sector.
- Management of the research-project cycle, from preparation through implementation to review, including the conduct of participatory, on-farm research and eliciting of feedback from farmers.
- The preparation and management of research and service contracts with commercial organisations and NGOs, and the management of patenting, licensing and royalty agreements.
- Proposed mode of implementation:
- Revise curricula of graduate and post-graduate training in agricultural universities and curricula of NAARM etc. which provide in-service training to agricultural scientists.
- Train faculty of these organisations in these areas.
- Provide adequate teaching materials.
- Promote exchange of scientists between ICAR institutes, SAUs, private commercial organisations and larger technology-oriented NGOs.

4. Improve mechanisms in research planning and management

Proposed mode of implementation:

- Even out the flow of funds to the institutes in a financial year.
- Broaden scientific research committees.
- Strengthen management of the research-project cycle by making the relationship between, activities, outputs and purposes more transparent (eg, by using the logframe format).
- Organise at least one-third of the resources for research on problem-area basis.
- Make research-information systems and telecommunications more fully reliable.
- Provide opportunities to hire scientific staff on a contract basis.
- Maintain operational expenses for research at a minimum of 30% of the institute budget.
- Jointly review research infrastructure by ICAR and state universities to rationalise research infrastructure.
- Provide more incentives, strengthen housing and other facilities and develop a sound and transparent transfer policy to facilitate those serving in remote areas.

5. Try out alternative approaches to extension

Proposed mode of implementation:

- Enhance use of mass media in message delivery, para-extension workers, and group-based approaches to extension.
- Strengthen multi-agency approaches in extension (private agencies, farmers co-operatives, NGOs, etc).

6. Develop human resources in extension

Improve extension personnel's skills in the following areas:

- Needs-assessment techniques, including the role of such techniques as participatory rural appraisal.
- Group formation, development of leadership skills.
- Conflict resolution and negotiation between different interest groups.
- Management of common-property resources.
- Use of different types of media.
- Communication.
- Project preparation.
- Data collection, analysis and documentation. Proposed mode of implementation:
- Joint committee at state level with representatives from SAUs, KVKs and state line-departments to streamline and strengthen training procedures for extension staff.
- Provide training for faculty members in relevant training organisations.

7. Review ICAR's involvement in extension

Proposed mode of implementation:

- Limit ICAR funding on extension to 10% of Plan budget.
- Review KVKs individually against their mandates, and close or relocate those performing poorly.

8. Strengthen research support for micro-watershed rehabilitation

Proposed mode of implementation:

- Expand this programme to cover more rainfed areas.
- Provide funds for contract research in the hands of agencies implementing these programmes.

9. Change the regulatory framework in varietal release, plant breeding and seed supply systems

Proposed mode of implementation:

- Prepare a comprehensive and regularly updated database of characteristics of released varieties (eg, University of Wales-KRIBHCO efforts in the UK-supported Western India Dryland Farming Project).
- Relax procedures for seed release in individual states to allow easier and quicker release of materials.
- Involve NGOs and farmers groups in improving seed supply.
- Promote truthful labelling.

In ICAR institutions and SAUs, several items in Table 9 could be initiated through special technical sessions in the ICAR directors' meetings and annual conference of SAUs' vice-chancellors. Some may benefit from inputs from overseas institutes, such as IFPRI or ODI. Almost all the initiatives will require follow-up, often over a period of years if their full advantage is to be availed.

Various measures proposed for improving extension are already under experimentation in different states. The major task lies in drawing lessons out of them and implementing these measures widely in all the rainfed states. The national workshop on training, planning and management held annually by the Directorate of Extension of the Ministry of Agriculture would be an appropriate forum to initiate curricula changes in extension-training institutions. The MANAGE is expected to play a major role in enhancing the skills of senior extension officials of different states for initiating the proposed reforms.

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