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Foreword

The National Agricultural Research System in the country has evolved through several phases. The first phase since Independence, can be visualised as expansion phase, wherein the system increased in terms of number of institutions and activities. The second phase in the 1970s could be termed as consolidation phase, increasing intensity of the activities. In the third phase since 1980s, the system concentrated mostly on management issues to improve efficiency of the system. These management issues will continue to dominate in future with the increase in number and complexity of research issues.

To address research and management problems, Indian Council of Agricultural Research has initiated a number of research reforms under National Agricultural Technology Project (NATP), which aim to improve relevance and efficiency of research. The new paradigms of research management underscore participatory, transparent and bottom-up approach of research planning and management. The system has been evolving specific action plans to institutionalise these improved mechanisms in the system under the guidance of specially constituted advisory bodies. A series of workshops have been organised to evolve and share new mechanisms and to sensitise the stakeholders. This publication brings out the proceedings of four important workshops which have been organised to institutionalise improved research prioritisation, monitoring and evaluation, and interaction with private research organisations.

I hope this publication will be useful in dissemination of new paradigms of agricultural research management and specific tasks to be accomplished under the NATP. I welcome comments and suggestions to improve direction of research reforms in general and research prioritisation, monitoring and evaluation in particular.

March, 1999

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Acronyms and Abbreviations

AED	Agro-Ecosystem Director
AESR	Agro-Eco-Sub-Region
AgGDP	Agricultural Gross Domestic Product
AICRPDA	All India Coordinated Research Project on Dryland Agriculture
ARIS	Agricultural Research Information System
ARPIS	Agricultural Research Project Information System
ATMA	Agricultural Technology Management Agency
CGIAR	Consultative Group for International Agricultural Research
CII	Confederation of Indian Industry
CRIDA	Central Research Institute for Dryland Agriculture
CSIR	Council for Scientific and Industrial Research
DARE	Department of Agricultural Research and Education
DBT	Department of Biotechnology
DOR	Director of Research
DST	Department of Science and Technology
FAO	Food and Agriculture Organisation
FICCI	Federation of Indian Chambers of Commerce and Industry
CIS	Geographical information system
HRD	Human resource development
IARC	International agricultural research centre
IAR1	Indian Agricultural Research Institute
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
INM	Integrated nutrient management
INTA	Institute National de Tecnologia Agropecuaria (Argentina)
IPM	Integrated pest management
IPR	Intellectual property rights
IRR	Internal rate of return
ISNAR	International Service for National Agricultural Research

ITK	Indigenous technology knowledge
MIS	Management information system
MNCs	Multinational companies
MOU	Memorandum of understanding
NAARM	National Academy of Agricultural Research Management
NARP	National Agricultural Research Project
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NBPGR	National Bureau of Plant Genetic Resources
NCAP	National Centre for Agricultural Economics and Policy Research
NGO	Non-governmental organisation
NPV	Net present value
NRC	National Research Centre
RAC	Research Advisory Committee
R&D	Research and development
RFC	Research Programme Committee
RPF	Research Project File
PCAARD	Philippines Council for Agriculture, Forestry and Natural Resources Research and Development
PME	Prioritisation, monitoring and evaluation
PI	Principal investigator
PIU	Project Implementation Unit (of NATP)
PPS	Principal Production System Scientist
PVP	Plant variety protection
SAP	Scientific Advisory Panel (of Agro-Ecosystem)
SAREP	Strategic adaptive research and extension plan
SAU	State Agricultural University
SRC	Staff Research Council
TAR	Technology assessment and refinement
TOT	Transfer of technology
UGC	University Grants Commission

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March, 1999 Editors

Part1 National Workshop on ICAR-PRIVATE SECTOR INTERFACE IN AGRICULTURAL RESEARCH

(April 2, 1998)

1.1 Workshop Recommendations

Characterization of Functional Domains

1. Characterize and target the potential domains of multiple stakeholders based on the comparative advantages to minimise overlapping of functions, wastage of resources and the time lag between technology generation and adoption
2. Identify potential roles of private sector and establish complementary linkages with public sector for jointly increasing the investment in agricultural research which is crucial for sustained food and economic security
3. Develop mutual confidence and trust among the multiple stakeholders for promoting partnership mode in agricultural technology management in the country
4. Evolve mechanisms for accreditation for private R&D, MOU for forging functional relationships and protocols for transferring/sharing technologies, materials and unique facilities and disseminating successfully functioning models in the private sector
5. Develop comprehensive database covering private sector role in agriculture: major stakeholders and their functions, research and development infrastructure, hardware and software facilities and expertise available
6. Maintain the balance between multiple stakeholders with a long term perspective which should have an in-built public sector capacity to sustain the functioning systems even in uncertain situations
7. Simplify regulatory policies and speed-up the implementation process without compromising On safety regulations
8. Transparent and clearly spelt out bio-safety provisions to be in position for exploiting research and market opportunities emerging nationally and globally

Identification of Complementary Linkages

1. Intensify the human resource development initiatives through initiation of fellowships and professor chairs by private sector in focused areas of research in NARS
2. Continuous updating of curriculum with active support from the private sector is emphasized to develop human capital in tune with the expectations of the private sector
3. Modernise and fine-tune the research infrastructure in NARS to effectively respond to changing demands of the private sector
4. Intensify interaction between various science and R&D departments like ICAR, DBT, DST, CSIR, UGC etc., for integrated knowledge application and efficient agricultural technology management in the country
5. Integrate the planning and functioning of multiple stakeholders in the national agricultural sector for effectively meeting the current as well as potentially emerging demands for inputs and services
6. Utilise revolving fund scheme for multiplying good quality seed material and subsidise quality seed supply with buy-back arrangements
7. Diversify the crop/product coverage for tapping new opportunities like focusing on contractual research on medicinal plants between NARS and drug industries
8. Strategic dissemination of mutually complementing outputs from the public and private sector activities for providing multiple options for the farmers matching with their varying resource, production, market and institutional environments

9. Provide for a proactive role for the private sector in guiding, planning and implementing applied research activities of the public institutions
10. Jointly target the custom production of seed through the public-private sector partnership for exploiting the global trading prospects
11. Comprehensively document the major service functions that are available for hiring/sharing from NARS institutions and publish it for disseminating the capital intensive hardware and software facilities and expertise acquired in frontier areas of research for promoting their joint exploitation by multiple stakeholders
12. Prepare an updated roster of expertise in the private sector for appropriately involving them in the agricultural technology management process within NARS
13. Early decision on IPR and PVP legislation, regulating and testing mechanisms relating to transgenics to catch up with the fast emerging technological advancements

Interfacing and Institutionalisation

1. Constitute broad based independent functional groups representing all stakeholders for effectively interfacing between ICAR, SAUs, private sector, NGOs, cooperatives and farmers in the areas of crops, horticulture, livestock, fisheries and machinery sectors
2. Organise series of brainstorming sessions on the public-private sector interface at national, regional, state and institutional levels for evolving multi-tier interface linkages at different levels of partnerships
3. Standing Policy Planning Committee should be broad based by including experts from the private sector
4. Hold a brainstorming session exclusively on the public-private sector interface for germplasm and seed related issues
5. Constitute a broad-based forum for continuous interaction on the sharing of genetic resources covering IPRs, testing of transgenic plants and depositing all genetic materials under dual lock system in the National Gene Bank facility of NBPGR to preserve national heritage for posterity
6. Develop MOU for sharing of genetic materials between public and private research organisations
7. Develop region specific agricultural technology parks and product development laboratories for promoting effective agricultural technology management in a partnership mode between public research institutions and corporate sector
8. Private sector should step up investment in agricultural R&D substantially and its role in the dissemination of technologies should also be strengthened
9. Expand and strengthen the legal and policy cell of the Council in the IX Plan to match with the increasing demands from the proposed interfacing between the public and private sectors
10. Initiate dialogue on the patenting of micro-organisms in the country

Action Plan

1. Council to make Standing Policy Planning Committee broad based by including private sector expertise. Initiate brainstorming sessions on the public-private sector interface at national, regional, state and institutional levels to promote multi-tier interface linkages and partnerships
2. Council to constitute functional groups with major stakeholder representatives for effectively interfacing between the public and private sectors. The groups should represent the areas of crops, horticulture, livestock, fisheries and machinery sectors. Prepare an updated roster of expertise from private sector for appropriately involving them in agricultural technology management process within NARS
3. Council to strengthen the Legal and Policy Cell during the IX Plan
4. NBPGR to organize a brainstorming session on the public-private sector interface exclusively for germplasm and seed related issues. Constitute a broad-based forum for continuous interaction on sharing of genetic resources covering IPRs, testing of transgenic plants and depositing all genetic materials under dual lock system in the National Gene Bank facility of ICAR to preserve national heritage for posterity

5. NRC on Plant Bio-technology to organize meetings with the private sector to document the existing capacity for bio-technology research in the country
6. IASRI should (a) document the major service functions that are available for hiring/sharing from ICAR institutions, (b) bring out a bulletin on "ICAR Services to Industry" for disseminating the capital intensive hardware and software facilities and expertise acquired in frontier areas of research for promoting their joint exploitation by multiple stakeholders, and (c) develop a comprehensive database covering private sector's role in agriculture: major stakeholders and their functions, research and development infrastructure, hardware and software facilities and expertise available
7. Policy Cell of the Council to develop the pro forma and guidelines for facilitating the mechanism of accreditation for private sector R&D institutions
8. Policy Cell and NCAP to develop MOU and other procedures for interfacing functional relationships with the private sector

1.2 Workshop Proceedings

Workshop Background

The National Agricultural Research System (NARS) in India is currently responding to the process of reforms being experienced in agricultural, economic and scientific environments. While reorienting to match the increasingly complex research demands with severe competition for public funds, the need for innovative institutional arrangements for identifying and exploiting the potential complementary linkages between public and private sector institutions is increasingly recognized. Multiplicity of stakeholders like ICAR institutes, SAUs, traditional (non-agricultural) universities and other institutions and government departments in public sector and corporate industries, private institutions, MNCs, cooperatives, NGOs, progressive farmers, farmers' associations, and service/input agencies in private sector provide potential opportunities for facing emerging challenges in the area of agricultural technology management. Such complementary research resource and technology management related opportunities available in the public-private sector interface domain remained by and large unexplored in the past. The enhanced role of private sector involvement in agricultural research started with the economic reforms initiated in the country starting 1991, especially economic liberalization, new seed policy, discussion on IPR and PVP, increased capacity of users for paying for technology, need for public sector to shed routine research and perceived need for a faster dissemination of technologies. Initiating dialogue among all the stakeholders and institutionalising the potential interfacing among them at various levels is essential for maximizing overall efficiency of agricultural research system. Such a process is emphasized during the implementation of NATP during IX Five Year Plan.

At the initiative of ICAR, a one-day brainstorming session on ICAR-Private Sector Interface in Agricultural Research was organized to deliberate on the issues relating to the exploitation of complementary linkages between public and private sectors and the need for institutionalising such interfacing linkages. The meeting was attended by scientists, research managers, planners, private sector executives, exporters and officials from NGOs and cooperatives.

Brainstorming Session

Chairman: Dr R. S. Paroda, Secretary, DARE and DG, ICAR
Rapporteurs: Drs S. Selvarajan and Rasheed Sulaiman V, NCAP

ICAR has identified key research areas for private sector involvement which formed the basis for orienting the presentations and discussions that followed during the brainstorming session. NATP also proposes to provide support to institutions in public and private sectors, through competitive grant programme, for research in identified problems and pilot testing of technologies for commercial use. Suggested areas for coverage included (i) hybrid seeds, (ii) transgenic plants, (iii) agricultural chemicals, (iv) veterinary products, (v) agricultural machinery, (vi) micro-propagation, (vii) use of plastics, (viii) post-harvest technology, (ix) value addition and product development, and (x) technology assessment.

The issues deliberated upon during the session for an improved public-private partnership were;

- Developing a complementary role for the private sector
- Building an environment of trust between the two sectors
- Developing an agreement on sharing basic information and materials (e.g. germplasm)
- Use of public institutions for R&D by the private sector and provision of contract research
- Arriving at agreement on IPR and PVP Q Institutionalisation of private-public sector interface

Chairman's remarks

While making introductory remarks and also while intervening in the discussion, the chairman highlighted various efforts being made by ICAR in developing effective linkages with the private sector. These include reconstitution of Policy Planning Committee of ICAR with more representation from private sector and representatives of FICCI and CII, opening up the public sector research institutions for contract research, contract services and consultancy, establishment of an IPR cell at ICAR headquarters, improved information system through ARIS, etc. Such measures are going to he further strengthened under NATP. ICAR is also encouraging SAUs to develop technology parks wherein professionals from public and private sectors can work together in developing products.

The chairman stressed on specialized HRD to meet the specific needs of the industry. He further emphasized that the private sector has much better understanding of market driven research needs in the areas sue!, as value addition, quality improvement, etc. The efficiency of the public system will be greatly improved/enhanced by establishing an active interface with the private sector.

While outlining the need for initiation of sector-wise dialogue with all the stakeholders for an in-depth understanding on their activities, the chairman exhorted the group to consider the following points while planning for intensive interface between public and private sector:

- Subject matter divisions of ICAR should hold separate interface meetings with private sector institutions working in their respective areas.
- This should be organized on a continuous basis so that new suggestions could be taken care of as frequently as possible.
- Mechanism of accreditation needs to be perfected. This may necessitate a review by ICAR on research facilities of private research institutes. Systems, procedures and pro forma need to be finalised.
- Public and private sectors should share their facilities and expertise which are complementing and mutually advantageous for the society at large.
- Partnership with the private sector should go beyond technology generation to encompass continuous assessment and refinement of technologies.
- Initiating four technology parks in the four regions of the country can also be thought about.

The chairman, in his remarks, strongly stressed that the public and private sectors should work together in a partnership mode to meet the increasing demands and expectations from agricultural research. This is possible only under an environment of trust and openness. These would help in identifying appropriate areas where both the sectors can collaborate. There is an urgent need to develop and sustain improved consultation mechanism between the two sectors for frequent exchange of views, ideas and concerns.

Based on the discussions and the remarks of the chairman, action plan was suggested for necessary follow-up and strengthening the on-going reforms under NATP.

1.3 Strengthening I CAR-Private Sector Interface in Agricultural Research (Background paper for the brainstorming session on "ICAR-Private Sector Interface in Agricultural Research" organised by NCAP. New Delhi.)

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1. Introduction

The national agricultural research system (NARS) in India has successfully ushered 'green, yellow, white, and blue revolutions'. The country is not only self-sufficient in food production but also in a position of strength in the world market in some commodities. The accumulating body of evidence indicates significant contribution of agricultural research (hereafter research) to the growth of agricultural total factor productivity, generating impressive rates of returns (Kumar and Rosegrant, 1994 and Rosegrant and Evenson, 1992).

However, recent changes in agricultural, economic and scientific environments have significant bearings on the national research policy. Commercialisation of agriculture, diversification towards high value crops, conservation of natural resources, development of marginal areas, increasing consumers' preference for quality products, intellectual property rights (IPR) related constraints in technology transfer, etc. are some of the new challenges, besides continuing priority for household food and nutrition security and poverty alleviation. Economic liberalisation provides new opportunity of export-led growth in agriculture through achieving and exploiting export competitiveness. On the scientific front, advancement in biotechnology provides new avenues for attaining higher productivity levels, stabilising crop yields and reducing research lag. In order to respond to these new, complex research needs and to avail emerging growth opportunities, research system has to be more strong and vibrant.

Research system can be strengthened by diversifying funding and institutional arrangements, and increasing overall efficiency of the system. Increasing dependence on public funds may not be sufficient to attain desired level of research intensity (Pal and Singh, 1997). Therefore alternate sources of research funding should supplement the public funds. These funds should be utilised through appropriate institutional arrangements. As argued in this paper, private sector can play an important role in this direction. Public and private sectors can interact in several ways for providing research services, depending upon their comparative advantage and national research needs. For increasing research efficiency, public and private sectors can come together to articulate research needs and design a strategy to address them. The sharing of prioritised demand-driven research agenda by public and private research institutions on the principle of comparative advantage in conducting research, can improve overall research efficiency manifold.

This paper first discusses the rationale for and current status of public-private sector interface in research. This is followed by a discussion on the measures which are important for strengthening the interface iri the Indian context. Finally, the paper raises important issues for discussion.

2. Research System: The Role of Private Sector

Indian NARS is dominated by the public funded and administered institutions, namely, Indian Council of Agricultural Research (ICAR) and state agricultural universities (SAUs). The participation of private sector in research is at the margin. The country is spending 0.42 per cent of its agricultural gross domestic product on research (1992-94, three-year average). Of this, 85 per cent are public funds and the rest 15 per cent is contributed by the private sector (Pal and Singh, 1997). This level of research intensity is not only much lower than that in developed countries (2.4 per cent), but also inadequate to address expanded, complex

research needs. The private sector can help bridge this gap in research intensity, besides enhanced government support for research. Currently, the private sector is investing in those technologies which can be embedded in inputs (embodied technologies), viz., chemical (pesticides and fertilizers), mechanical and biological (mainly hybrids) technologies. Most of these private investments are supporting in-house private research efforts and not much interest is shown to support research in the public or other institutions.

Private research investment has responded well to favourable regulatory policies and research support of the public institutions. For example, implementation of the New Policy for Seed Development in 1988 and free access to public research materials (inbred lines) have induced private investment in hybrid seed research (Singh et al., 1995 and Pray et al., 1991). This indicates that further efforts to strengthen the linkages between public and private sectors and favourable policy support would ensure healthy growth of the NARS and efficient delivery of improved technologies to end users.

2.1 Rationale and determinants of private research investment

Private sector can efficiently provide those goods and services which can generate profits. Therefore, private sector's participation in research would depend upon the scope for appropriability of technologies. The rate of appropriability would be high in those goods and services which have high excludability (exclusion of non-authorised users) and high subtractability or rivalry (extent to which a product can be used by one person). If we look at the characteristics of research products, embodied technologies developed through applied research are classified as toll or private goods as these have moderate to high degree of excludability and subtractability. Therefore, embodied technologies can be provided efficiently by the private sector. But new knowledge generated through basic research is classified as public good having low excludability and subtractability and therefore can be provided by the public sector. Since agricultural research by definition is applied research, participation of private sector is justified on economic grounds. Some applied research like crop and resource management research generating information based disembodied technologies having low appropriability in short term, may not attract private research investment. Therefore, presence of the public sector is essential to provide disembodied technologies (For detail discussion on these issues, see Umali (1992)). In the Indian context, effective demand for technologies is also constrained by preponderance of small and marginal farmers. The public sector has a special obligation in this regard. Further, the efficiency of applied research is contingent upon basic research support and therefore close interaction between the public and private sectors is inevitable.

Determinants of private research investment

As noted above, main determinant of private research investment is the ability of private firms to appropriate research benefits which, in turn, is affected by technology demand and supply factors, nature of technology and government regulatory policies (Pray and Echeverria, 1991 and Umali, 1992). These factors in the Indian context are discussed below.

Demand for new technologies: The demand for new technologies is determined by size of the market and price and income levels. Given the size of agricultural sector, commercialisation of agriculture and growing demand for agricultural products, there is continuous expansion in the demand for new technologies in the country. Product prices, including research products, are influenced by sectoral (input and output prices) and macroeconomic policies (fiscal policy, trade policy, exchange rate, etc.). Greater reliance on market forces and integration of the economy with rest of the world would ensure competition and efficient functioning of markets. Relative market prices would decide direction of research by allocating more resources to those commodities which are in high demand. New economic policies aimed to accelerate the pace of economic development would further increase the demand for new technologies in two ways. First, higher agricultural income would directly increase the demand for new technologies, and secondly through higher demand for agricultural products due to increased non-agricultural income. Thus, assured, expanding

market for new technologies is conducive to attract private research investment in the country.

Supply-side factors: Private research investment is significantly influenced by the supply-side factors like cost of research, scientific opportunities and basic research support. Research cost consists of cost of inputs (capital, stock of knowledge, manpower) and technical efficiency of the system (Umali, 1992). Since public research system is strong in India, it will continue to provide basic research support and trained scientific manpower to private research institutions. Furthermore, quality of scientific manpower, developments in science, particularly in biotechnology, and accumulating stock of knowledge can improve the technical efficiency and reduce research lag and cost of research in the private sector. Thus, there are strong reasons for increasing the pace of private research investment in the country. Apart from these supply-side factors, nature of technology also affects the private investment. For example, development of double cross hybrids attracts more investment as these hybrids inherently exclude non-authorised commercialisation of technology (Singh et al., 1995).

Public policies: Private research investment is also determined by macroeconomic, agricultural and research regulatory policies. Macroeconomic and agricultural policies affect private research investment as these policies have significant effect on the prices of commodities and inputs and research cost. The economy-wide reforms initiated in 1991 are expected to strengthen the private sector. Similarly, research regulatory policies are reformed to attract the private investment. These reforms include lifting restrictions on the entry of foreign-owned companies, liberalising import of seed/germplasm under the New Policy for Seed Development and increasing access of private research programmes to public research material. The ICAR is also encouraging contract research with the private sector and other organisations. Tax exemptions on research expenditure and sale of certified seed, and provision of 'truthful labeled' seed sale under the Seed Act of 1966 are strong stimulating factors for the private investment.

Another important regulatory policy encouraging private research investment is the protection of proprietary material. The Indian Patent Act of 1970 excludes products, agriculture and horticulture from patentability. In consonance with the World Trade Organisation, the new patent bill is under debate. But the success of new patent laws in terms of mobilising private research investment would depend upon their smooth and effective enforcement.

3. Public-Private Sector Linkages

Private sector institutions which can participate in research are of two types. First are the private companies (input, processing, etc.) who appropriate research benefits and generate profits for the owner. In the second category are the non-profit private organisations like research foundations, cooperatives, fanners organisations and non-governmental organisations. Resources, if any, raised by these organisations are reinvested in research. Participation of these two types of private organisations in research can be in the form of funding and/or execution of research. Depending upon the nature of research (basic, applied or adaptive), public and private sectors can participate in several ways in the funding and execution of research. As seen from Table 1.1, most of the interactions would be in the funding and execution of applied research. The public sector should share the responsibility of basic research, applied crop and resource management research, training of manpower and enforcement of regulatory policies. A significant part of applied and adaptive research should be in the private sector. However, this compartmentalisation may not be so simple in real world situation and research programmes in both the sectors can interact at different stages of research. These interactions can be operationalised in the following modes:

1. Consultative: for research prioritisation
2. Collaborative: in the funding and execution of applied research
3. Contractual: private funding of public research programmes, public research services to private sector on cost recovery basis
4. Client: providing basic and strategic research support to the private sector

5. Supervisory: ensuring competition and quality of services and enforcement of regulations

3.1 Lessons from the international experience

Table 1.2 shows the share of private sector in the total research expenditure. Developed countries like USA and UK which have large market, well developed science infrastructure and strong intellectual property rights, private sector, mainly input industries, contributes more than half of the national research expenditure. On the other hand, in the developing countries like India and Brazil, the share of private investment is low in spite of well developed science infrastructure and markets. Lack of IPRs, strong presence of public sector in inputs industry and restrictive domestic policies might be constraining private research investment in these developing countries.

As seen from Table 1.3, private research investment is confined to chemical, food processing, machinery, livestock/animal health, plant breeding and plantation crops. Among these areas, food and post-harvest research accounts lion's share of private research in Australia, Japan, New Zealand, USA and

Table 1.1. Public-private sector interactions in funding and execution of research

Activity	Public research institute	University	Private for-profit	Private nonprofit	Example
1 . Research Basic	F*E*	F E			New knowledge
Applied					
Embodied		F E	F*E*	F E	Hybrids
Disembodied		F* E*		F E	Crop and resource management
Adaptive					
Embodied			F E	F E	Seed management
Disembodied				F E	Crop and resource management
2. Manpower training		F E	P	P	Education and training in frontier areas
3 . Regulations	F E		P	P	Varietal testing and release

F : funding: E : execution; P : payment for services
# indicates strong comparative advantage

Table 1.2. Share of private sector in agricultural research expenditure, 1993

Country	% share of private sector
United States	53
United Kingdom	63
Japan	51
Germany	58
Australia	10
Mexico[a]	28
Philippines[b]	32
Brazil[c]	8
India[d]	15

[a d]1995 [b] 1992 [c] 1991
Source: Pray and Umali-Deininger (1998) and Alston et al. (1998) [d] Pal and Singh (1997)

Netherlands. But chemical research including agricultural related pharmaceuticals research is major focus of the private sector in USA, UK and Germany (Alston et al., 1998). Plant breeding research is of moderate priority for private investment in developed as well as in developing countries.

The cases of public-private joint ventures in research and emerging lessons are less documented. The joint venture of INTA with private sector in Argentina for the development and commercialisation of technologies is quite successful (Echeverria et al., 1996). In India, ICAR has also recently initiated a joint research programme on hybrid rice with Mahyco research foundation. Similarly, joint efforts of public sector and NGOs for community-based applied and adaptive research are experimented. One of the prerequisites for the success of these joint ventures is the planning and execution of a demand-driven research agenda.

Table 1.3. Priority areas of private research expenditure in agriculture

Priority area	Private research expenditure (US $ million)		
	Philippines (1995)	India (1992/93)	USA (1992)
Machinery	small	1.4	394
Chemicals	2.6	12.6	1,279
Livestock/ animal health	1.5	1.7	306
Plant breeding	1.8	4.9	400
Plantations	4.7	2.0	Small
Food	small	8.1	1,633

Source: Pray and Umali-Deininger (1998. draft version presented at the Sacramento conference)

4. Institutionalisation of ICAR-Private Sector Interface

It is clear from the foregoing discussion that several precondition' for the active participation of private sector in research exist in India. There are well developed science and other infrastructure facilities, and markets for inputs and new technologies are expanding rapidly. Public research organisations, particularly ICAR, have initiated a process of reforms to respond to new R&D challenges and to actively involve private sector in the national R&D efforts. Important steps in this direction are:

- Institutionalisation of improved research priority-setting, monitoring and evaluation with active participation of stakeholders
- Access of public research material, e.g., inbred lines to the private sector
- Special thrust on contract research and consultancy
- Competitive research grants open to all participants including private sector
- Strengthening of IPR cell
- Modernisation of research infrastructure
- Development of information system
- Major thrust on human resource development

These efforts can be strengthened by an intensive and continuous dialogue between the ICAR, SAUs and the private sector. These dialogues should cover all aspects of research like priority-setting, raising of resources, manpower training, technology development and testing, commercialisation of technologies, etc. The proposed brainstorming session is aimed to make a beginning in this direction.

5. Issues for Discussion

The following are the specific issues for discussion:

1. What are the areas where private sector has comparative advantage?

- In which areas one might expect private research investment?
- Whether main research programmes of multinationals will be located in India?
- Can private sector help attain the desired research intensity level of 1 per cent of AgGDP?
- Whether the private sector would cater to the needs of small farmers in marginal areas?

2. What mechanisms/protocols are needed to ensure fair and adequate basic research backup from the public sector?

- How the private sector can participate in the national research planning process?
- How to assess the performance of private research with its changing structure due to mergers and new alliances?
- What are the preconditions for the success of public-private joint research ventures?
- Mechanisms/protocols to share research resources and to extend basic research support?

3. What policy incentives are needed to encourage private R&D investment?

- Macroeconomic and sectoral policies
- Regulations governing import and exchange of germplasm, varietal testing and release, seed certification, etc.
- Bilateral and multilateral trade agreements
- Intellectual property rights-whether domestic private companies can withstand the IPRs?
- How the recent changes in public policies, science and industry structure would affect competitiveness, research cost and quality of services?

4. How can non-profit entities (NGOs, farmers organisations, cooperatives) participate in this process?

- Research planning, technology testing and refinement, etc.
- Sources of funding, research areas, impacts and experiences
- Necessary support for effectiveness of non-profit entities

5. How to institutionalise the mechanism for the public-private sector interactions?

- Areas of interactions
- Size and composition of interaction groups/bodies
- Frequency of interactions

References

Alston, J.M.; P.O. Pardey and J. Roseboom (1998), Financing agricultural research: International investment patterns and policy perspectives, World Development, 26(6): 1057-1071.

Echeverria, R.G.; E.J. Trigo and D. Byerlee (1996), Institutional Change and Effective Financing of Agricultural Research in Latin America, World Bank Technical Paper 330, Washington D.C.

Kumar, P. and M.W. Rosegrant (1994), Productivity and sources of growth for rice in India, Economic and Political Weekly, Dec. 31: A183-188.

Pal, Suresh and Alka Singh (1997), Agricultural Research and Extension in India: Institutional Structure and Investments, NCAP Policy Paper 7, New Delhi.

Pray, C.E. and D. Umali-Deininger (1998), The private sector in agricultural research system: Will it fill the gap?, World Development, 26(6): 1127-1148.

Pray, C. E. and R. G. Echeverria (1991), Private sector agricultural research in less-developed countries, in Agricultural Research Policy: International Quantitative Perspectives, P.O. Pardey; J. Roseboom and J.R. Anderson (eds), Cambridge University Press.

Pray, C. E.; S. Ribeiro; R. A. E. Mueller and P. P. Rao (1991), Private research and public benefits: The private seed industry for sorghum and pearl millet in India, Research Policy, 20: 315-324.

Rosegrant, M.W. and R.E. Evenson (1992), Agricultural productivity and sources of growth in south Asia, American Journal of Agricultural Economics, 74: 757-761.

Singh, R. P.; Suresh Pal and M. L. Morris (1995), Maize Research, Development and Seed Production in India: Contributions of the Public and Private Sector, Economics working paper 95-3, CIMMYT, Mexico.

Umali, D. L. (1992), Public and Private Sector Roles in Agricultural Research: Theory and Experience, World Bank Discussion Paper 176, Washington, D.C.

1.4 Programme

April 2, 1998

Chairman: **Dr. R. S. Paroda**
Secretary, DARE and DG, ICAR

Rapporteurs: **Drs S. Selvarajan and Rasheed Sulaiman V, NCAP**

Inaugural Session

1030	Welcome About NATP International Experience	Dr. S.D. Sharma, IASRI Dr. G.L. Kaul, ICAR Dr. Catherine Ives, Michigan State University
	Chairman's remarks	Dr R. S. Paroda, ICAR
1130	Tea	

Private Sector Research: Trends, Experiences, Expectations and Identification of Issues

1145	Presentation by the participants	
1245	Discussion on the identified issues	
1300	Lunch	
1400	Discussion on the identified issues (contd.)	
1500	Tea	
1515	Arriving at consensus and follow up steps	

Plenary Session

1645	Chairman's Remarks Vote of thanks	Dr. R. S. Paroda, ICAR Dr. Mruthyunjaya, ICAR

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Part II International Workshop on INSTITUTIONALISATION OF RESEARCH PRIORITISATION, MONITORING AND EVALUATION IN INDIAN NATIONAL AGRICULTURAL RESEARCH SYSTEM

(July 21-23, 1997)

2.1 Workshop Recommendations

General Assessment

1. Basic mechanisms for informal research priority-setting and monitoring are currently used which need improvement
2. Systematic application of innovative priority-setting approaches is lacking
3. Research evaluation and impact assessment is too weak.

Guiding Principles

1. Continuous commitment to improved priority-setting, monitoring and evaluation (PME) needed at the highest policy level
2. Where appropriate, improve design and implementation of existing PME mechanisms
3. Successful PME has to be linked to decentralised project-based funding and personnel performance evaluation
4. Initially institutionalisation should be implemented in phases at selected research centres
5. PME must be fully integrated with research decision making (e.g., mechanisms to drop unproductive/unsatisfactory projects)
6. PME methods should be simple, transparent and allow timely results
7. Institutionalisation should avoid bureaucratic structure
8. Continuous communication is needed with key stakeholders in PME activities
9. PME need to be integrated into project proposal formulation.

Priority-Setting Methods

1. Basic approach should combine participatory methods involving beneficiaries including farmers' organisations, and scoring/check list methods at project level
2. Should pilot benefit-cost analysis at selected applied research institutions
3. Finalise and provide guidelines on research priority-setting methods at regional and micro-levels
4. Develop a network of practitioners in PME activity.

Monitoring and Evaluation

1. Revise Research Project Files (RPF) which should integrate performance evaluation, ex ante evaluation and research funding decisions
2. Develop simple management information system (MIS; with key variables and indicators to be implemented for funded projects based on improved RPFs.

Institutionalisation

1. Policy advisory group should meet regularly and be proactive
2. Need simultaneous reforms in administrative procedures including financing system (project-based funding) and personnel performance evaluation
3. Need for multidisciplinary PME unit (preferably headed by economist) at the ICAR, SAU and Institute level
4. Representation of stakeholders in technical divisions and outside bodies as appropriate
5. Manualisation of guidelines for PME as part of project cycle (project formulation, screening, monitoring evaluation and ex post impact analysis)
6. Pilot implementation of improved PME at 5-10 programmes (institutes/SAUs) of diverse structures/mandates that are closely involved in NATP by integrating Subject Matter Divisions of the Council
7. Needs baseline information and performance indicators, which must be evaluated after 2-3 years
8. Ad hoc processing of proposals by NATP/PIU for funding under NATP using improved PME. NATP/PIU requires mechanism for screening proposals according to PME criteria
9. Simultaneously build awareness for replication throughout system through a series of workshops.

Training

1. Organise workshops and appreciation courses to sensitise top-level research managers
2. More in-depth training for selected scientists and economists in methods for research priority-setting and evaluation
3. Key role for NAARM in training in PME, assisted by NCAP, IARI, IASRI and other institutions with capability (including non-ICAR/SAU). Need specific courses, incorporation into orientation courses and materials for SAU curricula
4. Collaboration with international institutions in selected areas (ISNAR, IFPRI, ICRISAT, etc) for priority-setting methods and evaluation of natural resource management.

Action Plan

1. Constitute a working group at ICAR level to frame guidelines on research priority-setting methods at institute and project levels
2. Constitute a working group at ICAR level to (i) revise the RPF and (ii) develop manual, which provide guidelines for integrating improved PME approaches into project cycle
3. Identify few applied research institutions to pilot the improved PME before institutionalising in the entire NARS
4. Agricultural Research Information System (ARIS) should develop simple Management Information System (MIS) with measurable key variables and indicators while revising RPF
5. Organise workshops and appreciation courses to sensitize top-level research managers.

2.2 Workshop Proceedings

Workshop Background

National Agricultural Research System (NARS) in India is currently charting a proactive and futuristic role for agricultural technology management. Cost-effective agricultural technology generation requires rationalisation in research prioritisation, resource allocation and system organisation. Promoting complementarity and minimising overlapping research functions

within the NARS as well as international institutions are the guiding principles for reorganising agricultural research. Translating the vision of revitalising NARS for a responsive, efficient and futuristic role necessitates a systematic approach to institutionalise priority-setting, monitoring and evaluation (PME). The inherent strength of Indian NARS lies in its Capacity to draw lessons from past experiences and utilise the existing strong complementary linkages with several national and international institutions. Current focus on the institutionalisation of mechanism in Indian NARS is one such process being pursued under National Agricultural Technology Project (NATP) for keeping the system continuously responsive to external dynamism.

In order to prepare an action plan for institutionalising PME in Indian agricultural research system, a workshop was jointly sponsored by ICAR and World Bank during July 21-23, 1997. This workshop reviewed current PME mechanisms in the system and drew lessons from other NARSs and international agricultural research centres (IARCs) to strengthen these mechanisms.

Workshop Objectives

The workshop was designed to evolve the mechanisms for institutionalisation of improved capacity in PME. Specific outputs targeted from this workshop were as follows:

- The approach, including methodologies for PME
- Strategies for initiation, improving analytical capacity and information base for PME
- Needed resource scheduling and management and training support for sustaining PME.

Workshop Structure

Fifteen resource persons drawn from national and international agricultural research systems, shared their professional and institutional experiences. Three technical sessions, viz., research prioritization methods, institutionalisation aspects and national experiences and lessons, provided the focused presentation and discussion based on which another technical session was exclusively conducted for crafting recommendations. This session for formulating implementable strategies was organised through three parallel sessions of subgroups for specific discussions on priority-setting at national, institute and division levels; monitoring and evaluation (M&E) methods at scientist, programme and institute levels; and institutionalisation of PME at macro and micro-level including development of information system. The issues emerged during the three technical sessions were further iterated in these sub-group discussions for bringing out specific recommendations under each of the identified areas. These were once again presented, discussed, integrated and modified while finalising the medium-term and long-term recommendations.

Technical Session I: Research Prioritisation Methods Chairman: Dr H. K. Jain, Former DDG, ISNAR

The first technical session focused on analytical methods available and evolving continuously in the area of PME. Priority-setting methods used at the system, institute, research programme and project levels were discussed. The major issues for the institutionalisation which emerged during the discussions were:

- Target for simple and transparent priority-setting methods
- Methods should capture both demand and supply side considerations
- Make the trade-offs between research objectives transparent and explicit
- Aim for bottom-up approach with stakeholders participation
- Develop flexibility in priority-setting methods appropriate for different levels
- Provide feedback from ex post analysis to validate key parameters for ex ante priority-setting analysis
- Identify simple measurable indicators for M&E

- Match the needed research resources and project activities
- Define the periodicity for M&E
- M&E experiences should provide feedback to the planning process
- Link M&E outputs with the performance appraisal of the project team, and develop reward and incentive structure for better performance.

Technical Session II: Institutionalisation of PME: Case Studies Chairman: Dr Mruthyunjaya, ADG (ES&M), ICAR

This session deliberated on the institutionalisation of capacity in the system at all levels. Recent experiences of PCAARD and ICRISAT were analysed in great detail. The purpose was to identify strengths, weaknesses and adaptability of these models for replicab ility in Indian NARS. International experiences (ICRISAT model) have potentials for institute level adaptation while safeguarding against individuals and leaders based institutionalisation process (PCAARD model). Institutionalisation related specific issues which emerged from the international experience were:

- Develop a comprehensive view of the organisational behaviour to recognise the existing complexity .
- Attempt for organisational changes through institutionalisation that can be sustained
- Decentralisation does not end with multiplying budget making centres
- PME, MIS and budgeting are not to be treated as technical issues but as socio-technical and management issues
- Form a powerful guiding coalition with assured and sustained commitment from the top-level management. Create and communicate a vision for institutionalisation and empower others (scientists) to act on that vision
- Identify programme leaders for priority research areas in an interactive mode ensuring the overall confidence of project team members
- Allocate budget specifically to projects, and percolate down to activities and project team members
- Timely information about availability of funds to identified research priority areas
- Flexibility of converting non-plan and plan research funds.

Technical Session III: Indian Experiences and Lessons Chairman: Dr Dayanatha Jha, Director, NCAP

The third technical session focused on the available Indian case studies, covering institute and zonal research station level decentralised priority-setting activities. These experiences highlighted the felt need among the scientists to adapt for improved PME methods. Empowerment of scientists at all levels to pursue this vision will have positive and sustained impact within the system. Along with this, other activities like management information system, budgeting and incentive system should be treated as a single package and not in isolation while scheduling the process of institutionalisation. Issues emerged from the Indian experiences were:

- Integrate PME with research planning process
- Develop in-house capacity and specialised units for PME
- Committed resources for PME institutionalisation process
- Assess training needs of analysts, PME team/units and research managers
- Concentrate more on PME institutionalisation process and not the analytical methods
- Create information base on economic and technology related variables

Technical Session IV: Issues for Formulating Recommendations Chairman: Dr S. S. Johl, Former Chairman, CACP

Three sub-groups were constituted for synthesising the recommendations based on the issues generated during the first three technical sessions. The workshop was designed in such a way to provide about half of the time for such group discussions covering research

priority-setting at macro and micro levels, monitoring and evaluation methods, and institutionalisation of capacity and information systems. Guidelines were provided to the sub-groups to facilitate structured discussion and outputs.

General guidelines for discussion groups

- Identify the principles for improving PME in agricultural research in India
- Propose concrete action for the next 2-4 years under NATP for phased institutionalisation and resource needs for installing PME as an integral part of research planning and management in Indian NARS
- Suggest steps for prioritising research proposals for support under NATP at programme and project level
- Indicate the modalities of integrating PME into project cycle for the production systems research supported under NATP
- Highlight the linkage for feedback from production systems research to mission mode research and teams of excellence under NATP.

Plenary Session Chairman: Dr R. S. Paroda, Secretary, DARE and DG, ICAR

The recommendations of sub-groups were placed before the full house for more refinement. After one more iterative exercise, based on me feedback from the participants, final recommendations were modified and integrated and presented in the plenary session. While stressing the need for ensuring efficient agricultural technology management at all levels within NARS, the chairman flagged the following areas as a starting point for the group's consideration :

- Identifying easily quantifiable indicators of monitoring the performance of project, scientists and management personnel for improving efficiency of agricultural research
- Revising the RPFs and framing appropriate guidelines for integrating PME into project cycle and research management process at all levels within the NARS
- Planning for continuous human resource development through appropriately structured training modules to match the changing needs of research administrators in ICAR and SAU system
- Strengthening the internal review system within NARS by orienting the existing mechanisms like Research Advisory Committee and Quinquennial Review Team, etc. in a proactive and interactive mode by drawing from other national and international institutes' experiences like CGIAR Centres.

The chairman, in his concluding remarks, strongly suggested for a concrete action plan to initiate and install a permanent mechanism for identifying research priorities, programming resource allocations, monitoring the progress and evaluating the ex ante and ex post impacts of research projects for the NARS as a whole in an integrated and phased manner. The remarks of the chairman and the final recommendations of the workshop were synthesised for the Council's consideration and implementation.

2.3 Institutionalisation of Research Prioritisation, Monitoring and Evaluation in Indian NARS (Base paper for the workshop on 'Institutionalisation of Research Prioritisation, Monitoring and Evaluation in Indian NARS').

Suresh Pal and Dayanatha Jha National Centre for Agricultural Economics and Policy Research New Delhi

1. Introduction

Accelerating food production was the main challenge for agricultural scientists for the first three decades after Independence. This evolution was driven by area expansion in the first phase and by productivity growth in the second. Research managers had a relatively simple

task of research resource allocation in the context of this 'major' objective. Experience and judgement of scientists led to fairly efficient research resource allocation decisions and reasonable realisation of the objective.

The last decade, particularly these last few years, has added complexities. Regional balance, sustainability, trade-technology links, demand shifts towards non-food grains, income growth for the poor, are a few of the many new challenges confronting agricultural scientists today. With time, this complexity will grow further. On the other hand, availability of public funds for agricultural research is declining. Research managers find it difficult to address all the challenges and pursue all scientific options to tackle them.

These factors necessitate more analysis and use of some sort of decision rules along with technical information. Research planning and prioritisation has thus become a complex and specialised task. Institutionalisation of this process is, therefore, much more challenging in Indian NARS which is large in size and complex in research mandates. This brief paper outlines the methodological and operational aspects of such institutionalisation.

2. Levels of Analysis

Prioritisation is required at different levels. The ICAR lays out broad national priorities taking into account national needs and objectives. It identifies commodities and regions which are likely to face stress or which offer opportunities in the context of national objectives. It also has to take a long-term view of natural resource conservation and sustainability issues. Such ex ante judgements require analysis of expected costs and benefits.

Once the broad areas are flagged, a similar exercise has to be done for each of them. For example, if maize is identified as a priority crop, decisions have to be taken regarding where and what major research strategies should be adopted. There invariably are several feasible strategies, each with varying technological opportunities and varying degree of needed resources (costs). An essential input in this decision process is a scientific analysis of various constraints, corresponding (specific) options to tackle them, and judgement regarding the possibilities of alleviating these constraints. Once again some sort of optimising decision rules have to be applied to rank various options.

State Agricultural Universities and Zonal Research Stations which have research mandates for a state, region or zone, have to follow a similar approach to decide their research agenda. As one goes down the line, all parameters (constraints, options, costs, benefits) become somewhat more objectively measurable and research programmes/projects become sharply defined. Ideally, one would sum up the disaggregated profiles of priorities to arrive at the aggregate (national) agenda in a 'bottom up' planning approach. This should be the long-term planning approach.

Indeed this framework has been intuitively followed in the NARS. As mentioned earlier, subjective and intuitive judgements are inadequate in the context of contemporary complexity, formal analysis is the need of the day. Such capacity has to be built and, what is more important, institutionalised at all levels in the NARS.

This requires (a) access to information (data) on production structure and resources, (b) socio-economic factors driving these, (c) strong (scientific and technical) knowledge base, (d) analytical capacity combining agro-biological sciences and socio-economic expertise, and (e) an institutional mechanism close to top management at each level in the NARS. These are currently lacking. The purpose of this workshop is to suggest how to achieve this capacity and integrate it with management units at each level in the research hierarchy.

3. Methodological Issues

From the point of view of analysis, there are two main issues to be discussed. First, we briefly describe the choice criteria relevant for priority-setting and research resource allocation. Then the analytical approaches are indicated.

3.1 Choice parameters

Choice of research strategies is compounded by multiple criteria of evaluation. These are derived from broad national and agricultural sector goals. It is important to note at the outset that there are many instruments and policies to address these goals. Research is one of them. In many cases, other instruments are more effective. Without this understanding, choices are likely to be distorted as research managers, in their bid to garner greater political support, promise too much and then allocate scarce research resources to solve problems which are best tackled by non-research instruments.

With this caveat in mind, the important criteria or objectives which need to be considered are briefly indicated below :

a. **Growth:** To attain an overall economic growth of more than 7 per cent, the agricultural sector must grow at 4-5 per cent. This can come only through technology-based productivity growth. Agricultural research has a central role in achieving this.
b. **Efficiency:** To be globally relevant, this growth must be cost-efficient. Research options need to be assessed for economic efficiency in terms of real prices of factors and products.
c. **Sustainability:** Adverse environmental and ecological consequences of modern growth processes and trade-offs between short and long-term benefits are now better understood. This is demanding increasing attention all around.
d. **Trade issues:** In the wake of the new world trade climate, new trade opportunities and challenges are emerging. In addition, there are issues of technology gaps, technological dependence and intellectual property. The research system must remain vigilant and responsive to these considerations.
e. **Equity:** Accent on poverty alleviation requires that research contributions to this cause be also assessed. Equity in all three dimensions- regional, personal and gender, is important and research (technology) may influence this in positive or negative way.

It is obvious that these parameters interact among themselves. Intuition and subjective judgements fail to capture these complexities. Research managers need more information and analysis in order to make decisions about priorities and research allocation. In specific cases, other criteria (e.g., health, nutrition, energy, etc.) may be relevant depending upon the mandate of the institution.

3.2 Analytical approaches (This section Ls taken from Jha ct ill. (1995))

Methods reported for agricultural research priority-setting can be grouped into five categories: (1) scoring approach, (2) benefit-cost analysis, (3) programming model, (4) simulation model, and (5) econometric model. A brief description of each method is presented below.

Scoring/weighted criteria model

It is a commonly used method which involves identification of objectives for research system and choosing a set of criteria of measures of the contribution of commodities or types of research to the objectives. Criteria may be qualitative or quantitative in nature. Information on the commodities or research areas according to their overall contribution to research objectives are assessed for prioritisation.

Scoring models have the advantages that they can be administered in a relatively short period of time and are transparent, which facilitates their understanding particularly by administrators. They can be used to rank a long list of commodities as well as research areas, including non-production-oriented research. Qualitative as well as quantitative information can be used and perhaps most importantly, they facilitate the consideration of multiple goals and objectives. These models are often criticised because of their subjective weighting of multiple goals and objectives. Applications of these models are found in several studies like in the United States (Mahlstede, 1971), Argentina (Moscardi, 1987), Gambia (Sompo, 1989) and TAG (1992) review of priority and strategy for CGIAR.

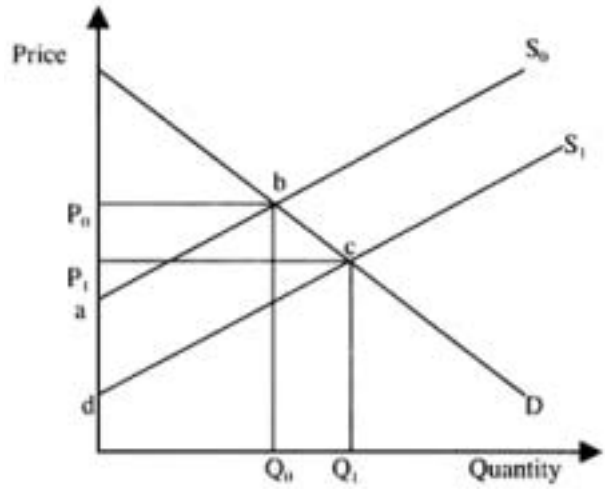
Benefit-cost (economic surplus) approach

The-economic surplus approach estimates returns to investment (generally, an average rate of return) by estimating the benefits from research in terms of the change in consumer and producer surpluses that result from technological change. Ex ante analysis usually incorporates expert opinion to determine projected research impacts, adoption rates and probabilities of research success, and provide estimates of the economic efficiency and distributional implications of agricultural research resource allocation.

Figure 2.1 illustrates the effect of technological change on economic surplus. The supply curve with the original technology is S_0 and the demand curve is D. The resulting equilibrium price and quantity are Po and Q_0, respectively.

Adoption of new technology, which reduces the unit cost of production (by raising yield) shifts the supply curve down from S_0 to S_1. This results in a new equilibrium price and quantity P_1 and Q_1 Consumers gain from the adoption of new technology because they can consume more at a lower price, and producers gain because their unit production costs fall. Net social benefit is the sum of consumer and producer surplus and is given by the area abed. The size of this benefit depends on the nature and size of supply shift.

Figure 2.1 Economic surplus model



The benefit-cost approach has the major advantage of incorporating several criteria related to economic efficiency and distribution into one or two measures. It can also be used to examine the general equilibrium effects of research; to assess the spillover of research benefits among different technologies, commodities, regions or countries; and to estimate the effects of agricultural policies on benefits arising from research. This method can be difficult to apply to a large number of commodities or research areas because types of data necessary for the analysis often do not exist for all commodities, li is also not well suited to rank non-commodity research areas. Applications of this method are found in studies in Peru (Norton et al, 1987), in eastern Caribbean (Norton and Douglas, 1989) and Australian Centre for International Agricultural Research (Davis et al., 1987).

Programming and simulation models

Programming models rely on mathematical optimisation to choose a research portfolio through maximising a multiple goal objective function given the resource constraints of the system. They have the advantage of explicitly incorporating the budget, human resource and other constraints in the system. Like scoring models, they facilitate the inclusion of multiple objectives. If constructed in a multi-period format, they can identify how the research portfolio should change over time. However, they require a great deal of analytical ability, data and time. An example of the use of this method is a study by Russel (1977) in the U.K.

In simulation models, mathematical relationships among variables are exposed 10 different scenarios to assess the best outcome. They can incorporate many factors that affect research priorities, such as multiple goals, research constraints, socio-economic variables, risk and uncertainty.

The advantage of simulation models is their flexibility. They can be constructed as relatively simple or complex tools, can incorporate optimizing or ranking procedures and can readily include probabilistic information. Their major disadvantage is that, to be useful they must be relatively complex and typically require extensive amounts of both data and time of skilled analysts. Anderson and Franklin (1977) and Lu et al. (1978) have used this method.

Econometric methods

The results of ex post analysis can also provide useful guidance for research resource allocation decisions if appropriately incorporated into systematic ex ante procedure. The most common ex post approach, in addition to the ex post benefit-cost analysis, is the econometric estimation of production or supply functions incorporating research variables. These econometric models assess the contribution of research to changes in production of different agricultural commodities. To be useful in ex ante analysis, econometric approaches must be applied with a high degree of disaggregation and good historical data on production, farm inputs and research expenditures.

Numerous studies have estimated these models (production functions, supply functions, profit functions, etc.) for ex post evaluation of agricultural research. While the results of these studies have been used to justify additional research funds for particular commodity; no research system has systematically used the results of a comprehensive econometric analysis for all its major commodities to help in setting research priorities.

There is no single approach that is suited for every situation. Each has advantages and disadvantages that affect its suitability for specific evaluation purpose, and in fact, it may be appropriate to combine different methods. The scoring and economic surplus approaches have been used more than the others.

Table 2.1. Comparison among major research priority-setting methods

	Characteristics	Scoring model	Economic surplus	Simulation method	Mathematical programming
1.	Requires explicit elicitation of goals	Yes	No	No	Yes
2.	Determines distributional effect on consumers and producers at various income levels	No	Yes	Yes	No
3.	Considers trade-off among goals	Yes	Sometimes	Yes	Yes
4.	Evaluates benefits to "aggregate" research	No	Yes	Yes	Yes
5.	Evaluates benefits to commodity research	Yes	Yes	Yes	Yes
6.	Evaluates benefits to non-production or non-commodity oriented research	Yes	Difficult	Sometimes	Yes
7.	Provides ranking of research projects based on multiple goals	Yes	No	No	Yes
.8.	Quantifies spillovers	No	Yes	Yes	No
9.	Relative ease of comprehension by decision makers	High	Medium	Low	Low

Source : Based on Norton and Davis (1981)

4. Information needs

The analysis requires considerable amount of information and data, covering both scientific (technical) and socio-economic aspects. These data should pertain to the level (national, state, zone) at which the exercise is intended. The following is an indicative list of such data.

Scientific information

- current, status of research
- constraints (technical and socio-economic)
- research approaches/options
- research resource needs
- probability of research success
- research and adoption lag

Socio-economic information

- supply, demand parameters
- farming system characteristics

- adoption possibilities, constraints
- yields, incomes, production, prices, inputs use
- externalities environment, gender, etc.
- market, policy environment

This is illustrative. As we deal with specifics, more and other kinds of information will be required.

5. Monitoring and Evaluation

An attempt was made under National Agricultural Research Project (NARP) to develop a system of monitoring research at participating SAUs. In the ICAR system too, an Agricultural Research Information System (ARIS) type system was introduced at the institute level. These have generally become defunct. Neither the scientists nor the management consider it important or useful.

Yet some kind of project information system is absolutely essential, not only for monitoring on-going research but also for research planning, prioritisation and resource allocation. It would not be an exaggeration to say that at present we don't have a very good idea of the disposition of research resources by commodities, resources, or problem areas. This must change. A simple, effective research project information system must be developed and adopted across the board in the NARS. In addition to our own Research Project File (RPF) and ARIS format, there are others which need to be looked into.

There are two reasons for 'no start' of earlier efforts. The more obvious one is that the project information system is not integrated with evaluation, either of individual scientist or of institution, or with any research planning. As such, it serves no purpose and is naturally neglected. The second reason is perhaps complexity of the format. The questionnaire is too cumbersome, it tries to cover a lot of information.

It is obvious that unless a workable research project information is set, systematic planning cannot be undertaken. What is needed is a two-fold strategy- a simple information system and the wherewithals to implement it, and secondly, an effective administrative mechanism linking this with evaluation of scientists and institutions. So long as such evaluations don't have teeth, the mechanism will not be taken seriously.

Other closely related aspects are the technology information system and research impact assessment. Institutionalisation of technology information system and impact assessment will help evaluation of achievements against targets. This will also provide feedback to research planning by looking at the extent and causes of deviations between targets and actual achievements. In addition, this will demonstrate research benefits, which are essential to justify enhanced research funding.

6. Institutionalising the Capacity

It is obvious that current capacity at various levels (national, regional, zonal) is inadequate to address the information and analytical needs of systematic research prioritisation work. An attempt was made under NARP to create some capacity at the Directorates of Research in various SAUs, but its focus was on monitoring and not prioritisation. Almost all constituent units of the NARS recognise the need for a planning unit; some of them have this unit, most address this through ad hoc processes (as and when five year plan is formulated). But, as mentioned above, such exercises are usually driven by a supply-side orientation, emphasising technical/scientific parameters and there is no analysis of socio-economic justification, impacts, or trade-offs-the main determinants of a demand-driven research agenda. Now that there is a consensus on the new paradigm, these deficiencies must be addressed.

Three issues are crucial. First, there must be a realisation at the decision-making level in each institution that (a) this is important, and (b) this requires rigorous socio-economic analysis. The inertia of convention has to be overcome. Second, this work must be (a) positioned right next to the research manager and draw directly from his authority, (b) be mandatory for all research institutes, (c) done by a standing team of scientists including economists, and (d) adequately backed by analytical and infrastructure support. Finally, existing capacity in this area in different research institutions is weak.

In order to address these issues, it is proposed to:

1. Create a small, permanent planning, monitoring and evaluation cell in the office of the research manager at different levels (headquarters, institutes, SAU, etc.). This cell must have access to data base, computers, networks, etc.
2. Make explicit mandatory provision for priority analysis for research plans/ projects screening.
3. Developing research project information system under the cell.
4. Linking project information system and analysis with Staff Research Council and other research approval mechanism.
5. Linking individual (scientist) and institution assessment and reward system with the project information system.
6. Arrange for training of planning cell staff in relevant economic analysis.
7. Provide overall orientation to scientists through in-house training, training programmes at NAARM.
8. Provide training materials, manuals.

7 Summing Up

The institutionalisation process aims to promote resource allocation and use efficiency in Indian NARS. Central to this process is the creation of well structured decision support system. No doubt, entire process of the institutionalisation should be objective and based on scientific principles. At the same time, one should see that the process is simple and easy to operationalise. The following guiding principles may help attain these goals.

1. The process should be objective and transparent so that research managers (and non-economists) can easily comprehend it. If not the analysis, at least end results should be understood by research managers.
2. It should establish links between policy makers, research managers, scientists and farmers.
3. The process should be an ongoing activity and provide decision support structure for research management.
4. The process should be iterative with participation of scientists and research managers in discussion of the results and their implementation.
5. The process should ensure strong links between basic, applied and adaptive research.

References

Anderson, Per Pinstrup and Franklin, D. (1977), A Systems Approach to Agricultural Research Resources Allocation in Developing Countries, in Resource Allocation and Productivity in National and International Research, C.T.M. Arndt, D.G. Dalrymple and V.W. Ruttan (eds), Minneapolis, Minnesota.

Alston, J. M., G. W. Norton and P. G. Pardey (1995), Science Under Scarcity- Principles and Practice for Agricultural Research Evaluation and Priority Setting, Cornell University Press, Ithaca and London.

Davis, J.S., Oram, P.A. and J.G. Ryan, (1987), Assessment of Agricultural Research Priorities: An International Perspective, ACIAR Canberra.

Evenson, R.E., R.W. Herdt and M. Hossain (1996), Rice Research in Asia: Progress and Priorities, IRRI and CAB International, Wallingford.

Jha, D., P. Kumar, Mruthyunjaya, S. Pal, S. Selvarajan and A. Singh (1995), Research Priorities in Indian Agriculture, NCAP Policy Paper 3, New Delhi.

Lu, Y., L. Quance and C.L. Liu (1978), Projecting Agricultural Productivity and its Economic Impact, American Journal of Agricultural Economics, 60: 976-980.

Mahlstede, J.P. (1971), Long Range Planning at the Iowa Agricultural and Home Economics Experiment Stations, in W.L. Fishel (ed.) Resource Allocation in Agricultural Research, Minneapolis, University of Minnesota Press.

Moscardi, E.R. (1987), Allocating Resources for Agricultural Research and Extension in Argentina: Experience of INTA, Paper presented at the conference on Allocating Resources for Developing Country Agricultural Research, Vellagio, Italy, July 1987.

Norton, G.W. and J.S. Davis (1981), Evaluating Returns to Agricultural Research: A Review, American Journal of Agricultural Economics, 63(4): 685-699.

Norton, G.W. and C. Douglas (1989), Analysis of Net Economic Benefits of Agricultural Research and Extension in Eastern Caribbean, SP 89-8 Deptt of Agricultural Economics, Virginia Polytechnic Institute and State University.

Nonon, G.W., V.G. Ganoza, and C. Pomareda, (1987), Potential Benefits for Agricultural Research and Extension in Peru, American Journal of Agricultural Economics, 69: 247-257

Russell, D.G. (1977), Resource Allocation in Agricultural Research Using Socio-economic . Evaluation and Mathematical Models, Canadian Journal of Agricultural Economics, 23 : 29-52.

Sompo Ceesay et al. (1989), Analysis of Agricultural Research Priorities in the Gambia, Paper prepared for the National Agricultural Research Board of the Gambia, March 1989.

TAC, CGIAR (1992), Review of CGIAR Priorities and Strategies (Part 1), TAG Secretariat, FAO, Rome.

2.4 Programme

July 21, 1997

Inaugural Session

Chief Guest:	**Dr. M.L. Madan, DDG (AS), ICAR**
Chairman:	**Dr. R.B. Singh, Director, IARI**

0930 hours	Welcome and workshop objectives Overview of research priority setting, monitoring and evaluation in ICAR and SAUs	Dr Dayanatha Jha Dr Mruthyunjaya
	Address by the Chief Guest Remarks by the Chairman Vote of thanks	Dr M. L. Madan Dr R. B. Singh Dr N. N. Singh

Technical Session I : Research Prioritisation Methods

Chairman: Dr H. K. Jain, Former DDG, ISNAR

1030 hours	Paper presentation by the resource persons*	Dr Derek Byerlee World Bank
1100 hours	Tea break	
1130 hours	Session contd.	Dr (Ms) M.C.S. Bantilan** ICRISAT
1300 hours	Lunch Break	Dr K.P.C. Rao, MANAGE

*Each presentation was followed by a brief discussion.
**Presented by Dr (Ms). M.C.S. Bantilan

Technical Session II : Institutionalisation of PME: Case Studies

Chairman: Dr Mruthyunjaya, ADG (ES&M), ICAR

1400 hours	Institutionalisation of the capacity Case studies - ICRISAT Philippines	Dr Paul Perrault, ISNAR Dr P. K. Joshi, ICRISAT Dr R. M. Juanillo
1530 hours	Tea break	PCARRD6

Technical Session III : Lessons from the Indian Experience

Chairman: Dr Dayanatha Jha, Director, NCAP

1600 hours Paper presentation by the resource persons

Dr H. K. Jain
Former DDG, ISNAR
Dr D. R. Bhumbla
Former VC, HAU
Dr R. B. Singh
Director, IAR

Open discussion

1730 hours	Poster presentation - Methodological: aspects and data requirements	Dr Stanley Wood, IFPRI

July 22, 1997

Technical Session III (Contd.)

Chairman: Dr K. P. C. Rao, Director, MANAGE

0930 hours Paper presentation by the resource persons

Dr J. C. Katyal, NAARM
Dr C. Ramasamy, TNAU
Dr J. Thakur, RAUV(B)
Dr Stanley Wood, IFPRI

Open discussion

11 30 hours Tea break

Technical Session IV : Issues for Formulating Recommendations

Chairman: Dr S. S. Johl, Former Chairman, CACP

1200 hours	ARIS Issues for formulating the recommendations	Dr Gajendfa Singh, ICAR Dr Suresh Pal, NCAP

1300 hours Lunch Break

1400 hours Parallel sessions of sub-groups

1. Priority-setting at the macro (i.e. national) and micro (i.e. institute/ division) levels
   Chairperson: Dr (Ms) M. C. S. Bantilan, ICRISAT
   Rapporteur: Dr Suresh Pal, NCAP
2. Monitoring and evaluation methods (individual, programme, institute level)
   Chairman: Dr Derek Bayerlee, World Bank
   Rapporteur: Dr P. K. Joshi, ICRISAT
3. Institutionalisation of priority setting at macro and micro level, including training and monitoring & evaluation
   Chairman: Dr Mruthyunjaya, ICAR
   Rapporteur: Dr (Ms) Alka Singh, IARI
4. Development of information system
   Chairman: Dr Gajendra Singh, ICAR
   Rapporteur: Dr S. Selvarajan, NCAP

1530 hours	Tea break	
1600 hours	Parallel sessions (contd.)	
1630 hours	Tea break	
1700 hours	Demo on the use of DREAM software for priority setting	Dr Stanley Wood, IFPRI
1930 hours	Workshop dinner	

July 23, 1997

Technical Session V: Finalisation of the Recommendations

Chairman: Dr Dayanatha Jha, Director, NCAP

0900 hours	Presentation of preliminary recommendations by the chairpersons of sub-groups Open discussion	
1130 hours	Tea break	
1200 hours	Finalisation and integration of the recommendations by subgroups	
1330 hours	Lunch break	

Plenary Session

Chairman: Dr R. S. Paroda, Secretary, DARE and DG, ICAR

1500 hours	Welcome Presentation of the recommendations Summing up (brief sum up as closure to the workshop) Remarks by the chairman Vote of thanks	Dr N. N. Singh Dr Mruthyunjaya Dr Derek Byerlee Dr R. S. Paroda Dr Dayanatha Jha

List of Participants

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5. Dr. Richard M. Juanillo*
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Part III Sensitisation Workshop on AGRICULTURAL RESEARCH PRIORITISATION, MONITORING AND EVALUATION

(August 26-27,1998)

3.1 Workshop Recommendations

- There is a need for more sensitisation workshops at Agro-ecosystem level with the help of case studies.
- Institutionalisation of PME is a strategy to improve research efficiency. It is a driving force both within and beyond NATP. It must be forthwith implemented, and institutions must earmark resources for this purpose.
- Research programme development, monitoring and evaluation must be fully integrated with funding, personnel evaluation and reward system to ensure that the procedure is effectively implemented. This has not been the case in the past.
- Research monitoring process should integrate monitoring tools, research resources and institutional aspects. It should also place equal emphasis on both quantitative and qualitative dimensions of research.
- NATP programmes must be integrated with on-going research programmes at various institutions. This is necessary for wholistic prioritisation approach.
- Agricultural economists should be provided in all the ecosystems on a permanent or temporary basis through redeployment in the PME cell.
- There should be an explicit mechanism for inter-institutional collaboration and developing a culture of sharing information (including methodologies), software, resources, etc. through networking. This is necessary to avoid duplication as well as to provide complementarity.
- ARIS should also provide value-added data on agriculture.

Action Plan

- Create a PME cell at the national, ecosystem and institute/SAU levels in the research system.
- Organise training programmes on PME methodology.
- Finalise RPF format and illustrate with an example.
- Develop a network of PME practitioners as soon as possible.

3.2 Workshop Proceedings

Background and Objectives

The NARS in India has evolved over time into a dynamic multi-institutional structure. It has eco-region and hierarchical dimensions which are further branched into commodity, resource and discipline modes. These complexities and increasing focus on demand-driven research warrant the use of improved PME mechanisms. Concerted efforts are being made under NATP to institutionalise improved PME mechanisms in the NARS. First workshop on the institutionalisation of PME was jointly organised by NCAP and IARI on July 21-23, 1997 to develop a framework of the institutionalisation process. The Task Force on PME has developed an action plan for the institutionalisation. The present workshop is a follow-up of the previous efforts.

The main objective of this workshop was to sensitise the research managers and scientists about the PME and share the action plan with them for necessary feedback and improvement. This workshop was organised with the following specific objectives:

1. To create awareness among the main stakeholders in NATP, viz. Agro-ecosystem Directors (AEDs), Principal Production System Scientists (PPSs), chairpersons of Scientific Advisory Panels (SAPs), Principal Investigators (Pis), etc. regarding proposed PME mechanisms,
2. To get feedback on the action plan for institutionalisation of PME,
3. To get feedback on the networking of practitioners of PME,
4. To initiate necessary action on the intitutionalisation process.

Workshop Structure

The workshop was structured into four technical sessions, viz. research prioritisation approach, research monitoring, research impact assessment and institutionalisation plan and networking. Important issues which emerged during these sessions were further discussed in the plenary session for finalising the recommendations. Technical presentations in this workshop were made by NCAP, NAARM, IASRI and ICRISAT.

Technical Session I Research Prioritisation Approach
Chairman: Dr G. L. Kaul, OSD, NATP
Rapporteur: Dr S. Selvarajan, NCAP

This session started with a brief presentation by the chairman on NATP and need for improving PME mechanisms in the system. He also explained objectives of the workshop and other expected follow-up action on PME institutionalisation. This was followed by a presentation on research prioritisation, which covered the issues like change in research management paradigm, need for an objective and transparent research resource allocation procedure, concept and methods of research prioritisation, information needs, etc. The presentation was supported with the available studies on research prioritisation in the country. It was clearly stated that NATP is only a vehicle to initiate institutionalisation process and finally this process has to be institutionalised at all levels (production system, eco-region, programme and institute levels). The presentations were followed by open discussion. It was clarified that research programmes and projects under NATP which were developed through intensive technical interactions, would form the basis for a prioritisation exercise and resource allocation decisions by SAPs and Project Management Committee (PMC).

The major issues on which consensus emerged were as follows:

- Improved PME mechanism is essential to enhance research efficiency.
- PME will be driving force both within and beyond NATP.
- There was a preference for simple, transparent and participatory research priority-setting approach.
- Flexibility in priority-setting methodology to cater the needs of various clients and stakeholders.
- Use of case studies on priority-setting for sensitisation of wider audience was recommended.
- There is a need for in-house capacity and information base. Training of economists and other scientists in the PME cell at the AED and institute/SAU level is necessary.

Technical Session II: Research Monitoring
Chairman: Dr S. K. Sinha, National Professor, IARI
Rapporteur: Dr C. Ramasamy, CARDS, TNAU

This session dealt with agricultural research information system (ARIS) and methods and approaches of monitoring of agricultural research. In his opening remarks, the chairman expressed concern over inadequate attention paid to research monitoring in the system. This

is partly due to complexity of procedures and largely due to delinking of research monitoring with planning and personnel performance assessment. A point was made that research monitoring should not be considered as a fault-finding activity, but a process to improve research efficiency through timely execution of plan activities and learning from past experiences.

The presentation on ARIS provided a comprehensive account of the implementation of the scheme. Achievements and targets of various components of ARIS were covered in detail. The component of agricultural research project information system (ARPIS) was discussed at length as this is more closely associated with research monitoring. A suggestion was made that value added data and data on important aspects of agriculture should also be made available through ARIS. For this, links should be established with other organisations which are compiling these databases. Some of the participants emphasised the need for improving electronic connectivity of information/ communication system.

The second presentation on improvement of research project file (RPF) system covered RPF I arid annual activity formats developed by NAARM. RPF I includes details of work plan, sub-projects, milestones, expected outputs, profile of research team, budget estimates, etc. The Annual Activity Form includes progress by sub-projects and will be submitted each year. These formats were discussed in great detail. The following issues emerged:

- The RPF format should also include some information required for research priority-setting, cost of scientific manpower and constraints/risk impeding project implementation.
- The format should be resilient to accommodate inefficiencies caused by administration like delay in release of budget and other resources.
- There should be a mechanism to compare targeted output with achievements in AAF.
- Frequent changes in project formats confuse scientists and put them in disarray. Some consistency with the format proposed for NATP projects may be maintained.
- Need for decentralised decision making for effective implementation of RPF system.
- Preparation of an illustrative RPF format using case study.

Third presentation in this session was on monitoring of research projects using 'Microsoft Project' software. This software is quite flexible in rescheduling of project activities. There was some degree of skepticism as well as optimism about the use of this software in monitoring of agricultural research projects. It was pointed out by many participants that monitoring should also place equal emphasis on incorporation of risk factors like experiment failure due to drought, pest outbreak, etc., quality of research and other qualitative aspects of research. Besides monitoring of quantitative indicators, importance of site monitoring of experiments should not be overlooked. All these aspects should be incorporated into monitoring mechanism and adequate hands-on training should be arranged. Finally, it was emphasised that research monitoring should be viewed as a mechanism to improve research efficiency and not a faultfinding activity. The approach should be a wholistic encompassing institutions, men, materials and monitoring tools.

Technical Session III: Research Impact Assessment
Chairperson: Dr(Ms) M. C. S. Bantilan, ICRISAT
Rapporteur: Dr K. P. C. Rao, NAARM

This technical session had one presentation based on ICRISAT experiences. In the opening remarks, the chairperson distinguished priority-setting exercise which deals with the potential (ex ante) research impacts, from impact assessment exercise which estimates actual (ex post) impacts of agricultural technologies.

The need for research impact assessment arises from decline in research funds, donors' demand to know about research pay-offs- and increased awareness about research evaluation. Funding agencies and planners now demand evidence that research is a productive investment. Four steps were involved in impact assessment work undertaken by ICRISAT: making an inventory of technologies; delineation of technology target domains,

picking up successful technologies for impact assessment; and not so successful technologies for constraint analysis. To measure the impact, farm level indicators used were efficiency, household food and nutrition security, risk management, poverty and gender issues, cropping intensity and natural resources conservation. The impact assessment exercise provided useful insights on the rates of returns, yield gains and adoption levels and refinement and retargeting of some of the technologies. Main lessons of the ICRISAT experience were:

- Support of top and middle level management and scientific community is essential for the impact assessment work
- The evaluation process should be simple, transparent and consistent to ensure support of all scientists
- The methodology should be flexible so as to adapt under local environment and for varying research outputs
- The impact assessment work can be taken up either at institute level or at project level
- To facilitate the impact assessment work, objectives of the project must be clear and indicators of achievements of objectives should be in measurable form
- There should be adequate in-house capacity for measuring research impact
- Efforts should be made to create a structural database to help assess research impact

In the discussion, participants appreciated the need for research impact assessment work and related database. It was pointed out that the impact assessment is important not only to convince the policy makers and donors for committing enhanced resources for research, but also to establish better relationship with the clients. Such work at ICRISAT has facilitated release of new varieties, revitalised technology dissemination process, provided feedback to scientists and assisted management to set research priorities.

Technical Session IV: Institutionalisation Plan and Networking
Chairman: Dr M. V. Rao, Former VC, APAU
Rapporteur: Dr P. K. Joshi, ICRISAT

This session deliberated on the proposed action plan to institutionalise PME in the NARS and networking of PME practitioners. The institutionalisation plan presented for feedback, highlighted the approach, levels of implementation, responsibilities at each level, training needs and database development. The PME approach should be simple, transparent, objective and participatory. The proposed plan should be implemented at three levels in the system, viz. national level (ICAR), agro-ecosystem level and institute level. At all the three levels, there should be a PME cell with direct access to decision-making authority. The cell should be responsible for priority-setting, monitoring and information system management. There should be consistency in PME approach at all the three levels, and PME exercise at each level should provide feedback to other levels. The information system should maintain data necessary for priority-setting as well as track current resource allocations. Research impact assessment work can be carried out independently or may be coordinated by PME cell. In order to develop in-house analytical capacity, NCAP, NAARM and IASRI will arrange training programmes in collaboration with lARCs like ICRISAT, IFPRI and ISNAR. The following main points came out in the discussion:

- Implementation of plan on pilot basis in one agro-ecosystem and few institutes/SAUs
- Immediate action on capacity building of human resources on research priority-setting and impact assessment methods
- Need for MOU to establish inter-institutional linkages in research programmes
- Need to emphasise more on scientific commitment for successful implementation of research projects
- Need for integrating NATP with on-going research programmes

Some concern was expressed over the institutionalisation plan as its implementation may further delay NATP research projects, which are developed after several interactions. It was

clarified that the plan aims to improve research efficiency by explicitly incorporating cost-benefit considerations. The technical interactions do not cover this, but are essential inputs for prioritisation analysis. This consideration must be placed before the reviewing bodies (SAP, PMC) in addition to technical parameters. Furthermore, NATP research programmes, particularly to be approved second year onwards, also are subject to improvement using improved priority-setting methods.

The presentation on networking of social scientists underscored the central role of agricultural economists in improved PME mechanisms. Since there is a dearth of agricultural economists working in this area, there is a need for establishing a network. The proposed network will bring together thinly spread PME practitioners, improve economies of scale through sharing of resources (manpower, information, etc.) and help organise training programmes. The network may operate through coordinating groups at the national and agro-ecosystem levels. It was suggested that some non-economists working in this area may also be covered under the network.

Plenary Session

Chairman: Dr K. V. Raman, Former member, ASRB
Rapporteur: Dr Suresh Pal, NCAP

This session synthesised important issues which emerged during discussions in the technical sessions and finalised the recommendations. Rapporteurs of technical sessions presented the reports highlighting main issues. This was followed by point-wise discussion. After some modifications and suggestions from the participants, recommendations were finalised.

General consensus was that institutionalisation of PME mechanisms is an aid to research management for further improving research efficiency. But the process should also ensure relevance, quality and timely completion of research projects through developing some kind of pressure or fear to excell. This calls for reforms in other research policies like financial management and incentive and reward system. The chairman in his concluding remarks said that it is rather difficult to assess the impact of this sensitisation workshop as sensitisation is a mental activity which is difficult to measure. But this workshop has made a beginning. There could be more such workshops at regional levels to reach wider stakeholders. PME is a dynamic process and therefore should be used continuously at all levels in the system. The process will help integrate NATP with on-going research programmes. Efforts to improve research efficiency should be governed by the principles of entitlement, empowerment, excellence, evaluation and equity (5Es). The improvement efforts should cover all the three stages of research, viz. planning or programme development, implementation and successful completion. Institutionalisation of improved PME would go a long way in attaining these objectives.

3.3 Institutionalisation of Research Prioritisation: Action Plan (Proposed action plan presented at the workshop. Comments from Drs Ashok Seth and Derek Byerlee on an earlier draft of the plan are acknowledged with thanks)

Suresh Pal
National Centre for Agricultural Economics and Policy Research
New Delhi

I. Concepts

Institutionalisation: Organisational, functional and/or institutional arrangements in the system for creating in-house capacity of research prioritisation on a continuous basis. Key elements of the process are:

- Integration with research management process
- Developing in-house analytical capacity for research priority-setting

- Developing management information system

Research priority-setting: Prioritisation of research portfolio for resource allocation based on expected benefits.

Levels of priority-setting: Levels in the organisational hierarchy at which research resource allocation decisions are taken (e.g., national, eco-region, institute/SAU).

Dimensions of priority-setting: Prioritisation for research resource allocation across:

- Commodities
- Eco-regions
- Research programme or problem areas within a commodity
- Research projects within a research programme

Eco-region: A production environment with homogeneous agro-climatic conditions, responding uniformly to technology. It is the recommendation domain for prospective technologies.

Responsibility: Fixing responsibility to carry-out specified tasks in time- who should do what?

II. Main Features of the Plan

Priority-setting approach

- Simple, objective and transparent approach which is easy to implement
- Participatory approach involving stakeholders
- Direct access to decision making authority
- Timely flow of information

Training needs

- Use of priority-setting methods Q Impact assessment methods Q Rural appraisal techniques
- Use of information technology (information exchange, access to database) Information system
- Socio-economic database
- Technology related parameters
- Tracking of research resources allocations (scientific, financial)

Resource needs

- Scientific and technical staff
- Computer hardware and software
- Operating expenses (travel, workshop, etc.)

III. Action Plan

1. National-level Priority-Setting

Table 3.1. National-level priority-setting plan

1.	Responsibility	Policy Planning Division of ICAR (proposed)
2.	Priority-setting Team	Agricultural Economists 4 Agro-biological Scientists 3
3.	Terms of reference of priority-setting team	I. Characterization of ecosystems II. To finalise the methodology consistent with the approach paper III. To develop economic and technological database IV. To prepare research priority matrix and indicate necessary adjustments in research resource allocations V. To support micro-level research priority-setting
4.	Dimensions of priority-setting	Commodity broken down by ecosystems
5.	Linkages	i. Digitization of database activity ii. ARIS
6.	Periodicity of priority-setting	Once in five years, reviewed every two years
7.	Training responsibility	NCAP in collaboration with NAARM, IFPRI and ISNAR

Note: Priority-setting team will be temporary and should be constituted at the time of priority-setting. However, it would be desirable if one member of the team is permanent to maintain consistency in priority-setting approach.

2. Agro-ecosystem level

Table 3.2. Agro-ecosystem level priority-setting plan

1.	Responsibility	Ecosystem Directorate
2.	Priority-setting Team	Agricultural Economists 3 Agro-biological Scientists 4
3.	Terms of reference of priority-setting team	i. Characterization of sub ecosystems ii. To finalise the methodology consistent with the approach paper iii. To develop economic and technological database iv. To prepare research priority matrix and indicate necessary adjustments in research resource allocations v. To provide feedback to macro-level research priority-setting
4.	Dimensions of priority-setting	Production system broken down by major research programmes and sub ecosystems
5.	Linkages	i. Digitization of database activity ii. ARIS iii. Strategic adaptive research and extension planning (SAREP) of districts iv. Agricultural Technology Management Agency (ATMA) v. Macro-level research prioritisation
6.	Periodicity of priority-setting	Once in five years, reviewed every two years
7.	Training responsibility	NCAP in collaboration with NAARM and ISNAR
8.	Administrative control	AED

Note: Some members of the priority-setting team may be permanent to take up the work of research monitoring and evaluation. After completion of NATP, micro-level priority-setting may be coordinated by the Regional Committees of ICAR.

3. Institute/SAU-level Priority-Setting

1. Institute/SAU-level priority-setting team should be larger in size (about 10 members) so as to represent major disciplines. The team would prioritise well focused research programmes under different research areas/themes. For example, under crop improvement, specific research programmes could be development of rice hybrids, short duration maize hybrids, cotton varieties resistant to boll worm, etc. Thus this exercise would supplement the eco-system-level priority-setting and help identify specific research projects.
2. Linkages with:

- Digitization of database activity
- ARIS
- Micro-level research prioritisation
- SAREP

- ATMA

3. Training for developing analytical capability will be provided by NAARM in collaboration with NCAP and ISNAR.
4. Periodicity: Continuous
5. Responsibility: Director of Research in SAUs and Director in ICAR institutes

Similar exercise can be undertaken at the Zonal Agricultural Research Stations i er the administrative control of Director of Research. However, most of information to be collected under SAREP of districts can directly feed to priority-setting exercise at the zonal level. For this, SAREP should emphasize collection of quantitative information on production constraints rather than simply listing of these constraints.

4. Project-level

Having macro and micro-level priorities in place, it would be too expensive to apply priority-setting methods at the project level. At the project level emphasis should be on the consistency of research proposals with the agreed priorities and quality of research proposals. Therefore, individual research proposals should be evaluated against scientific merit of the proposal, comparative advantage of the institution and principal investigator undertaking the research and cost effectiveness of the proposal. The check list given below may be used for screening the proposals.

Check list:

For objective assessment of the proposal against proposed criteria, following check list may be used by the Scientific Advisory Panel/screening committee:

1. Whether the proposal fits within the stated priorities of the production system?
Yes/No
2. Are the justification, objectives, hypotheses appropriate and clear?
Yes/No
3. Is the proposal technically sound and innovative; is the technical programme/methodology consistent with the stated objectives and hypotheses?
Yes/No
(Comments of the external referees may be used for (2) and (3). External review should assess research objectives, rationale, state of art, hypotheses, methodology, work plan, etc.)
4. Are activity milestones and monitoring indicators properly stated to track progress?
Yes/No
5. Whether host institution and principal investigator have comparative advantage in conducting the research?
Yes/No
(This aspect should cover specialization of principal investigator and availability of necessary infrastructure facilities.)
6. Does the proposal justify public expenditure?
Yes/No
(Is the private sector unlikely to take up this research?)
7. Is there evidence of a system, multidisciplinary approach including social scientists where appropriate?
Yes/No
8. Is the proposal cost effective for attaining the stated purpose?
Yes/No

(There could be more than one research approaches to attain the stated purpose and therefore cost effective approach should get priority.)

Funding decision: If answers to all questions in the check list are affirmative, research proposal may be recommended for funding under NATP. Here it is important to note that research cost of all the approved projects in a research programme should not exceed total cost of the programme, as any deviation in these costs would change priority ranking of research programmes.

IV. Tracking of Current Research Resource Allocations

1. Responsibility:

- National: ARIS cell of ICAR
- Ecosystem: Ecosystem Directorate
- Institute/SAU: Director of Research in SAUs and Director in ICAR institutes

2. Information to be compiled on

- Scientific manpower
- Financial resources

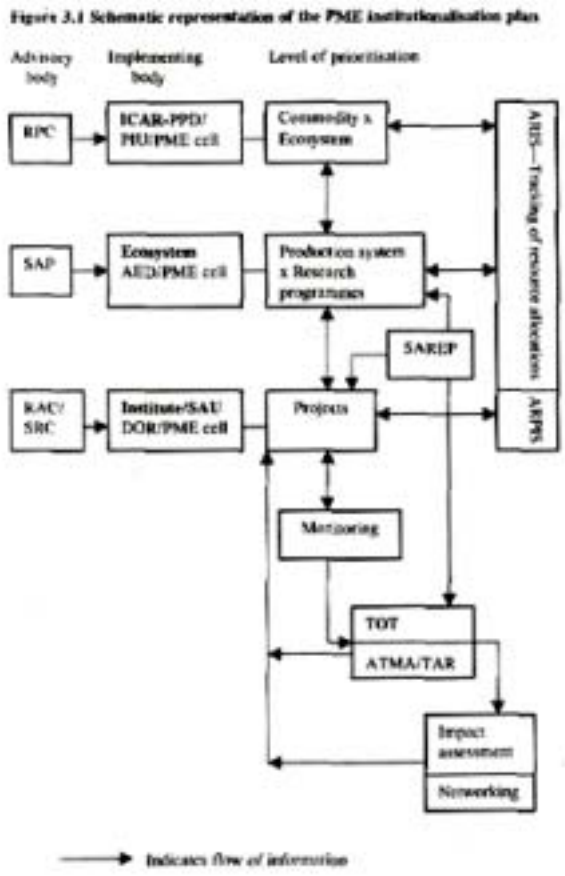
3. Linkages with ARPIS
4. Information format

Table 3.3. Information format to track research expenditure

Ecosystem	Institution	Production system	Commodity	Research theme	Resources			
					Number of scientists		Expenditure (000 Rs)	
					Total	FTE*	Non-recurring	Recurring
Irrigated	PAU	Rice-wheat	Rice	Variety Development				
				Crop Mgmt.				
				Resource Mgmt.				
				Crop protection				
				Post-harvest				
				Socio-economics				
			Wheat					

*FTE: Full-time equivalent

These information would be compiled by all institutions and passed on to AED of their ecosystem and to the ARIS cell of ICAR every year.



3.4 Programme

August 26, 1998

Session I: Research Prioritisation Approach

Chairman: **Dr G. L. Kaul, OSD, NATP**

Rapporteur: **Dr S. Selvarajan, NCAP**

1000	Welcome	Dr Dayanatha Jha
1015	Workshop background and objectives	Dr G.L. Kaul
1030	Research priority-setting: Concept, approach and methodology	Dr Dayanatha Jha and Dr Suresh Pal
1130	Tea break	
1200	Discussion	
1300	Lunch break	

Session II: Research Monitoring

Chairman: **Dr S. K. Sinha, National Professor, IARI**

Rapporteur: **Dr C. Ramasamy, CARDS, TNAU**

1400	Agricultural research project information system	Dr S.S. Tomar
1430	Discussion	
1445	Improving RPF system	Dr P. Manikandan
1515	Discussion	
1530	Tea break	
1545	Monitoring of research projects	Dr S.D. Sharma and Dr R.K. Jain
1615	Discussion	

Session III: Research Impact Assessment

Chairperson: **Dr (Ms) M.C.S. Bantilan, ICRISAT**

Rapporteur: **Dr K.P.C. Rao, NAARM**

1630	Research evaluation and impact assessment	Dr P.K. Joshi
1700	Research impact assessment-ICRISAT Experience	Dr M.C.S. Bantilan
1730	Discussion	

August 27, 1998

Session IV: Institutionalisation Plan and Networking

Chairman: **Dr M. V. Rao, Former VC, APAU**

Rapporteur: **Dr P. K. Joshi, ICRISAT**

0930	Institutionalisation of PME: Action plan	Dr Suresh Pal
1015	Discussion	
1100.	Tea break	
1 130	Networking of social scientists: Concept and strategy	Dr S. Selvarajan
1200	Discussion	
1300	Lunch break	

Plenary Session:

Chairman: Dr K. V. Raman, Former member, ASRB

Rapporteur: Dr Suresh Pal, NCAP

1500	Presentation of reports by the Rapporteur Discussion and workshop synthesis Chairman's remarks
1630	Tea

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Part IV National Workshop on RESEARCH PRIORITISATION OF RAIN FED RICE PRODUCTION SYSTEM

(December 14, 1998)

4.1 Workshop Recommendations

1. Characterisation of production system: First priority should be given to 47 predominant rainfed rice districts (out of 50) from the states of Bihar, Orissa and Madhya Pradesh. New districts like Basti, Gorakhpur, Siddharthnagar, and Champaran and predominantly kharif rice districts like Purulia, Bankura and Gandak may be considered for inclusion in the priority districts. Brahmaputra valley region in Assam may be considered at a later stage.

2. Training in research prioritisation: The interactions between social scientists and bio-physical scientists in research prioritisation exercise is extremely important. Concept papers may be prepared on important research issues in all the Agro-ecosystems (AESs). Training on research prioritisation methods may be arranged by NCAP. AEDs may nominate Principal Production System Scientist (PPSs) or an agricultural economist along with selected Principal Investigators (Pis) of the Production System Research (PSR) for this training.

3. Priority-setting analysis: In each AES, priority-setting analysis should be done to determine priorities among different production systems selected for each AES, among the problems and programmes identified for each production system (to begin with take only one system), and among -centers listed against each programme, using the model developed and presented by NCAP. The priority-setting among production systems would help in deciding the fund allocation among different systems, which should be decided before the review of individual research proposal is taken up.

4. Identification of critical research gaps: NATP is a different way of doing, business for. technology development and transfer. The ICAR Institutes 'should come forward to ensure success of PSR in the prioritised districts with concerted efforts to fill in the gaps. For a balanced research portfolio, need-based programmes may be prepared in animal sciences, horticulture, fisheries and agricultural engineering by the Subject Matter Divisions at the Council. Components of a programme cutting across-disciplines are to be identified for better implementation.

5. Involvement of ZARSs: Efforts should be made to fill in technological gaps identified from the impact analyses of NARP eco-regions through ZARSs/RRASs. For this, ICAR institutes, SAUs and ZARSs/RRASs are to be brought under a single umbrella for effective programme implementation, avoid duplication and strengthen the on-going programmes for efficient use of the available scarce resources. Voluntary agencies should be involved in the participatory mode of programmes.

6. Priority research areas: For rainfed rice based production system, top priority research programmes are: improve crop yield ceilings, rain water management for drought alleviation, control of parasitic diseases in livestock, sustainable livestock production system, weed management and soil quality improvement. It was suggested that funds for these projects may be released after ensuring the technical merits. It is further suggested that detail analysis may be done simultaneously.

7. Guidelines to other PSRs: The proposed research prioritization plan needs to be adapted by all the AEDs in formulating need-based priority programmes and allocating the funds with due care. SAP Chairmen may help in following this procedure in their AESs. A base paper for each PSR should be developed on the pattern followed in Rainfed Rice Production System. This should cover identification of districts/regions, inventory of resources, constraints, problems, potential, and on-going research efforts in the entire system. The paper should also identify research priorities to tackle the identified problems and the extent to which the research programmes identified under NATP fill the gaps. The base paper should be developed in consultation with the chairman of SAP. This will eventually be a valuable reference material for future.

4.2 Workshop Proceedings

Background

The workshop was organised to review the research programmes of rainfed rice-based production system in Rainfed Agro-ecosystem under the NATP. Main objective of the workshop was to review the research priorities for rainfed rice production system and to finalise the procedure for prioritising production constraints, research themes and location of

research centres where research is to be carried out. The workshop was attended by senior research managers in the Council, AEDs, chairmen and members of SAPs, World Bank representatives and leading researchers from national and international research institutions. Proceedings of the workshop were conducted in three sessions, viz. research priorities, research gaps and opportunities and research prioritisation approach.

Session I: Research Priorities
Chairman: Dr. R. S. Paroda, Secretary, DARE and DG, ICAR
Rapporteur: Dr. Suresh Pal, NCAP

This technical session dealt with characterisation of rainfed rice-based production system and prioritisation of research programmes to address production constraints. The chairman, in his introductory remarks, elaborated the importance of rainfed agriculture in general and rainfed rice system in particular, both in terms of high potential for growth as well as research resources committed. It is, therefore, essential to have a critical look at the system's constraints, proposed research programmes and available research infrastructure. Multiplicity of production constraints calls for a multidisciplinary research approach in a system perspective. The need for human resource development is vital to improve the quality of research. Upgradation of the equipment, travel, additional facilities, research support, etc. will be encouraged under NATP. Other important issues which need attention for effective research planning and implementation were as follows:

- JMATP activities must support the on-going research programmes. It should not be treated as separate entity.
- In a new paradigm, sustainability is the major theme of Production System Research.
- Need to adopt research consortium approach to avoid duplication and encourage team spirit.
- Wherever feasible, focus on micro-watershed based research.

Ii was also mentioned that about one-third of the total funds are made available for PSR and the success of NATP is contingent upon effectiveness of PSR. It is therefore essential to plan research programmes carefully through several interactions. The PSR planning process is decentralised where role of SAP assumes critical importance for:

- prioritising programmes for better returns from research investment
- refining the research agenda
- judicious selection of the programs based on research gaps and new paradigms/trade-offs.
- mid-term monitoring and impact assessment of research.

This was followed by a presentation on methodology for identification of rainfed rice-based production system. The criteria of SAT Agro-eco-sub-regions (AESRs 4-14), <40 per cent irrigated area and >20 per cent rice area under rainfed were used for delineation of rainfed rice production system. Fifty districts were identified under rainfed rice system in the states of Madhya Pradesh, Orissa, Bihar, Uttar Pradesh, and Maharashtra. In this region (> 1000 mm rainfall) scope for irrigation to increase rice yield is exceedingly limited and therefore crop and resource management aspects should get priority. The presentation also covered district-wise prioritisation of research areas and strategy. The procedure, followed in identifying the needs of the districts by utilising related attributes, indicator development and extent of rainfed area under consideration and the paradigm of the research area and problems, was presented. The output of the World Bank project on Sustainable Rain fed Agriculture (Module I) has been extremely useful to define the production system and prioritisation of programmes.

In the second part of this session, the base paper covering the methodology for research prioritisation and prioritised portfolio of the production systems in the Rainfed Agro-Ecosystem, constraints in rainfed rice production system and research projects was presented. The criteria used for prioritisation include expected benefits in terms of economic efficiency (rate of returns), food security, promotion of sustainability and equity aspects. The information on prospective technology-related parameters used in priority-setting analysis, were obtained through self assessment of the project by the Pis. Research projects were ranked based on expected impact (weighted score of all benefits). In addition, the vertical and horizontal delineation was done under resource constraints for identifying the problems related to research at different centers. The priority ZARSs were also identified. The team effort of AED (Rainfed) and NCAP in identifying priorities was appreciated.

While commenting on the base paper, participants drew attention to the following issues:

1. Priority assessment has highlighted the needs for increasing productivity and sustainability of rainfed rice system in the targeted districts through location specific and interdisciplinary research.
2. The importance of horticulture and livestock as important parts of rainfed rice system was appraised, but the integration of these aspects in the proposed research programme is lacking. This needs to be examined.
3. It is to be ensured that large agro-eco-sub-regions are adequately represented. Accordingly, the 18 ZARSs identified for the programme need to be reviewed for their coverage.
4. Crop, nutrients and water management research should be integrated to produce a synergistic effect.

5. Linkage between the on-going research programmes of ICAR in different Subject Matter Divisions and NATP should be established.
6. Interactions with the local scientists, extension workers and farming community need to be strengthened for ensuring participatory and location specific research.
7. Socio-economic analysis should be done right from initiation of a research programme and it should provide input to research resource allocation decisions.

Session II: Research Gaps and Opportunities
Chairman: Dr. G. B. Singh, DDG (NRM), ICAR
Rapporteur: Dr. K. P. R. Vittal, CRIDA

This session dealt with the identification of research gaps and opportunities in rainfed rice production system. It was pointed out by the chairman that research issues which are not covered under the IX Plan programmes should be taken up under NATP. He also mentioned that (i) newly formed districts of Uttar Pradesh may also be considered under rainfed rice production system as in the case of Bihar, (ii) identified priority problems of districts should be made available to research stations and co-operators before formulation of research projects, and (iii) database for the system may be updated regularly.

In order to have a system's perspective, inputs on direction of research thrust in animal sciences, horticulture and engineering were sought as these areas are not adequately covered in the proposed research programmes. In the case of animal sciences, it was emphasised that (i) a system analysis on livestock holding vis-a-vis rice production system, particularly in peri-urban areas should be looked into, (ii) there is a need for integration of crop and animal husbandry in a farming system perspective in rainfed region, (iii) separate benefit-cost analysis of low input-low output and high input-high output systems should be attempted, and (iv) high priority should be accorded to breed improvement and disease control research in animal sciences.

There was a consensus on identified priorities for horticultural crops. However, it was feared that programmes on floriculture, mushroom and hybrid vegetables may suffer because of inadequate research capability in the region. It would be better if greater emphasis is laid on introduction of new fruit crops like mango, litchi and cashew, spices research, increasing base of vegetable varieties, integrated nutrient management and organic farming for sustainability of horticulture systems. For agricultural engineering, it was suggested that introduction of new biasi implements, improved ferti-seed drills, decorticators etc. should be accorded high priority.

Other important issues which emerged during the discussion were:

- Greater emphasis on resource and crop management research for quick benefits
- Separate research strategy for different ecologies like uplands, lowlands and deep water in the system
- Innovative research programmes promoting diversification and exploiting opportunities in the system should be encouraged
- Need for greater interactions between intitutions and disciplines
- Need for involvement of stakeholders in research prioritisation.

Session III: Research Prioritisation Approach
Chairman: Dr. J. S. Kanwar, Former DDG, ICRISAT
Rapporteur: Dr. P. K. Joshi, NCAP

The chairman summarised the base paper on rainfed rice-based production system and elaborated key elements of the research prioritisation approach. There was consensus on the approach and it was agreed that this approach may be used for identification of research agenda for other production systems. However, it was felt that NCAP should further refine research priority-setting methodology for indicators of sustainability. Finally, it was suggested that the following issues should be kept in mind while developing the research proposals:

- Potential of the eastern region in meeting the national goals without expanding irrigation facility
- System diversification towards livestock and horticulture Q Recuperation of soils
- Improve potential of available indigenous technologies
- Changing land use patterns in the country with emerging labour constraint
- Need for toposequential research in the PSR with clients participation
- Made effective use of the recommendations emanating from the World Bank-ICAR project on Sustainable Rainfed Agriculture Research and Development
- Development and regular updating of database
- Involvement of stakeholders in research prioritisation exercise
- Utilisation of infrastructure developed in NARP with avoidance of pitfalls experienced in its implementation
- Effective integration of SAUs, State Governments, ICAR institutes, developmental programmes of Central Government to bridge gaps in TOT/TAR.

4.3 Research Prioritisation of Rainfed Rice Production Systems (Base paper for the workshop on 'Research Prioritasation of Rainfed Rice Production System'.)

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National Centre for Agricultural Economics and Policy Research
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Central Research Institute for Dryland Agriculture, Hyderabad

1. Background

There are enough indications that future sources of growth in Indian agriculture lie in the rainfed areas, which constitute a large chunk of about 90 million ha. The most critical and high potential rainfed region occupies nearly 67 million ha which is having the mean annual precipitation ranging between 500-1500 mm. This part is characterised by low productivity, slow and poor dissemination of new technologies, large concentration of poor people, high degradation of natural resources, including biodiversity and poor infrastructural facilities. Although the rainfed region is lagging far behind than the irrigated and other favourable regions, this region has considerable potential and opportunities as it possesses fairly good soil, high precipitation, enough human resource, large cattle population, etc. The Indian agricultural research system through its R&D programmes places very high priority to this lagging ecoregion with multiple goals of enhancing production potential, improving social welfare, controlling degradation of natural resources and exploring opportunities for crop diversification. Among several other research initiatives of ICAR, NATP has carefully delineated rainfed ecosystem among five agro-ecosystems in India for target and client-oriented research and technology transfer.

Like any other agro-ecological region, the rainfed region is constrained by large number of factors in enhancing agricultural productivity, adopting improved technologies and conserving natural resources. To address these issues, several research proposals have been submitted to the NATP for possible funding. These need to be prioritised depending upon their severity because research resources are scarce and production constraints are numerous. Such an exercise is essential to judiciously use the scarce resources for agricultural research. Before releasing the limited funds to the potential research proposals, NATP initiated a vigorous and critical technical review process. This is supplemented by an analytical research priority-setting exercise.

This base paper presents information on rainfed rice production system relating to: (i) constraints limiting agricultural production, (ii) prioritised research portfolio, and (iii) research gaps and opportunities.

The paper is organised in five sections. After providing the background, the second section briefly gives the recommendations of earlier reviews and comments of the consultant. It is followed by a section on new research portfolio, which delineates rainfed rice production system, and results of research prioritisation exercise. The fourth section lists major research gaps and opportunities in rainfed rice production system, which is followed by a list of issues for discussion.

2. Earlier Research Initiatives in Rainfed Rice System

Government of India took several initiatives to increase agricultural production, particularly rice, in rainfed rice production system. Among others, a comprehensive study (Sen Committee) for the rainfed ecosystem was sponsored by the Reserve Bank of India, which clearly revealed complexity of multiple problems in rainfed rice production system. Some of the key findings of the study were:

- inadequate drainage limits agricultural production and diminishes chances of increasing cropping intensity in lowland areas;
- high economic disparity amongst farming community, which warrants a graded systems of farming to suit economic conditions of different farming communities;
- tenancy is such that tiller often is not the owner, which discourages farmers to invest in agriculture; and
- rice is the most important crop, which is more suitable only in medium and lowlands.

Based on the recommendations of the Sen Committee, several research programmes were initiated in rainfed rice production system. Among others, SAUs under the umbrella of the All India Coordinated Research Project on Dryland Agriculture (AICRPDA), and National Agricultural Research Project (NARP) took up several research initiatives to improve the productivity of rainfed rice production system. Broadly, the following findings were reported:

- medium and lowlands are more productive than deep water regions;
- improved rice varieties of different duration (90-135 days) were identified for medium and lowland areas;
- line sowing of rice in bunded uplands, and transplanting on the lower end of slopes increases yields;
- rice/pigeonpea intercropping recommended for upland rice;
- feasibility of second crop after rice in lowlands have been identified but needs refinement;
- nutrient management based on the external sources has been examined, which needs to be integrated appropriately with the locally available organic sources;
- livestock is an integral component of farming system but not much research attention has been given to this system;
- persistent lack of draft power has not been seriously addressed;
- crop diversification received little attention;
- inadequate attention on institutional arrangements and infrastructure development;
- lack of systems approach to integrate research outputs in a watershed framework.

In a recently concluded project on 'Sustainable Rainfed Agriculture Research and Development', following researchable issues were listed (CRIDA, 1998):

- draft power is limited which needs special attention;
- efficiency of external inputs needs considerable improvement;
- technical know-how and accessibility of inputs is very poor;
- cropping intensity has to be further increased;
- improvement in fodder quality needs more attention;
- animal health needs special focus;
- establishing second crop after rice in lowland areas, and intercropping of rice and pigeonpea in upland areas need further refinement in view of farmers' resource endowments.

The above recommendations were reviewed by the NATP with the Division of Natural Resource Management of the ICAR, and Central Research Institute for Dryland Agriculture (CRIDA) to identify critical areas for future research in the production system framework. A list of research issues was then prepared in a workshop organized in August 1997, which was sharpened in a following workshop in April 1998 under the guidance of the World Bank Consultant, Prof. Ratan Lal, Ohio State University, Ohio, USA. The outcome of the brainstorming workshop with the consultant was identification of research and problem areas for rainfed rice production system (Table 4.1).

The World Bank Consultant (Prof. Ratan Lal) in his review of the production system and research projects pointed out following issues:

- With depleting cover, land degradation is likely to accentuate in future. Sectoral changes in land use must be reinforced with land reforms along with a comprehensive land use policy. Strict adherance to long term land use plans must replace popular political and 'myopic' economic considerations to control land degradation process.
- Fulfillment of sustainability goals (along with water) would necessitate greater nutrient inputs. The current imbalance in nutrient requirement and use is less certain to diminish in times to come. Fertilizer use efficiency will be the cardinal point of future research. Dependence on integrated nutrient management harmonizing man made (chemical fertilizers) and natural (organic, manure and biofertilizers) nutrient sources will become increasingly important because of economic, social and political compulsions. Keeping in view the limited availability of organic manure due to alternative uses, augmenting their supply by in situ raising a non-competitive way will make them more acceptable. In fact, arresting fall of organic matter below a certain minimum level will be the most potent weapon against unabated soil degradation and imperiled sustainability.
- Focused research interventions will be required to delineate priority land use systems, commodities and domains with intrinsic or introduced ability to transform gray parched tracts into green top areas and green regions which are greener in both time and space.

3. New Research Portfolio

Based on the key production constraints and identified research areas, the Principal Investigators from various research institutions and SAUs submitted research proposals for funding from NATP. These research proposals were prioritised based upon some national commitments for the rainfed ecosystem. This section describes the methodologies used for delineating rainfed rice production system and the results of empirically prioritised new research portfolio for rainfed rice production system.

3.1 Delineation of rainfed rice production system

To undertake more focused research in the rainfed rice production system, it is necessary to identify the research domain, which represents the predominant rainfed rice area. For this purpose, the data (1990-94 series) generated in a project on 'Sustainable Rainfed Agriculture Research and Development', was used (ICRISAT, 1998). Following steps were used to delineate the rainfed rice production system in India:

1. agro-eco sub-regions from 4-14 (delineated by the National Bureau of Soil Survey and Land Use Planning) were included because remaining sub-regions fall under different ecoregions, viz. arid, hill and mountain, irrigated and coastal. This step identified 280 districts.
2. districts having irrigated area less that 40 per cent were selected in the second stage. This step reduced the number of districts to 152.
3. districts having rice area more than 20 per cent of the gross cropped area were retained to focus rainfed rice. This yielded a list of 50 districts.
4. to maintain contiguity of districts, three districts (two in Uttar Pradesh and one in Maharashtra) were eliminated. This step confined to a cluster of 47 districts, which was characterised as rainfed rice production system.

Table -4.1. Problem areas in rainfed rice production system

Area	Project title as on April 1998
1. Characterization of resource base	1.1 Characterize the RRPS and geo-reference the dynamics of bio-physical and socioeconomic production sets to identify constraints of the production system 1.2 Assess production potential of the eco-zones to delineate favourable areas in rainfed ecologies using CIS integrated crop modelling approaches. 1.3 Medium range weather forecasting for planning farm operations and prognosis of crop plant diseases and animal diseases
2. Improving the productivity of different crop production systems	2.1 Introduction of rabi pulses/oilseeds on residual moisture after rice 2.2 Develop crop and nutrient management practices for rainfed hybrid/aromatic rice 2.3 Develop agrotechniques for vegetable cultivation and storage to maximize productivity of traditional upland rice areas 2.4 Develop contingency plans to combat aberrations in monsoon for stabilizing production system 2.5 Intensification of rice based intercropping system
3. Improving the water use efficiency for increased productivity	3.1 Develop geo-reference water availability inventories on toposequences 3.2 Develop rainwater harvesting, recycling and recharging techniques and integrate the aquaculture 3.3 Develop methodologies for prognosis of drainage system congestion to facilitate adoption of improved technologies in rice growing areas 3.4 Resolution of techno-socio-economic issues of tank irrigation systems for enhancing productivity 3.5 Develop tillage guide to reduce erosion losses and enhance productivity
4. Improve crop yield potential	4.1 Evaluate cultivars of rice of the production systems for different toposequences having different soilscape and nutritional constraints 4.2 Evaluate cultivars of major crops of the production systems for increased water use efficiency 4.3 Develop short duration fast growing Sesbania species suited to different conditions for use as fodder and green manure
5. Improve soil fertility and residue management	5.1 Develop integrated nutrient management practices for cropping systems in relation to water supply 5.2 Identify appropriate inoculants for moisture and temperature stresses and improve their survival in plough layers to enhance productivity 5.3 Organic pools and dynamics in relation to land use. tillage and agronomic practices for maintenance of soil fertility

6. Improve soil quality and resilience	6.1 Assess soil quality and degradation problems of soil and water resources for their impact on production losses 6.2 Development of regional watershed plans and methodologies for identification of critical areas for land treatment in the watersheds 6.3 Develop/refine technologies for rehabilitation of marginal and other degraded soils for prioritised treatment of areas in the watersheds
7. Evaluation and conservation of feeds and fodder	7.1 Assessment of locally available fodder, feeds, and other non-conventional feed resources 7.2 Evaluation of locally available feeds and fodder and improve their quality for animal feeding 7.3 Improve indigenous methods for conservation of surplus monsoon grasses 7.4 Improve techniques for cultivation of grasses/sesbania on rice field bunds, fallow marginal and degraded lands
8. Reduction in losses from weed and pests	8.1 Study weed and pest incidence dynamics in relation to weather and economic losses for developing effective control measures 8.2 Develop integrated pest management for the rice-based production systems
9. Processing and implements	9. 1 Develop equipment for Biasi bushening and incorporation of organics 9.2 Development of prototypes and promotion of implements for tillage and seeding in participation with local manufacturers/artisans 9.3 Improve indigenous technology for milling, drying and storage of rice
10. Development of alternate land use options	10.1 Develop rice based agro-forestry systems using Sesbania, Giliricidia, etc. 10.2 Develop mango/litchi based intercropping
11 . Improve productivity of livestock	11.1 Control of parasitic diseases of grazing and stall-fed livestock 11.2 Integrated land use round the year dairy based production utilizing fodder, rice straw and other rice mill byproducts 11.3 Integrated ruminant and non-ruminant based livestock production system

Note: Item 3.2 predicts on-set of monsoon and rainfall patterns to advance rice planting in the old version is merged with 1.3

The districts identified in step 4, cover about 85 per cent (about 10 million ha) of total rainfed rice area in the country. The average yield of these districts is nearly one tonne ha^{-1}.

3.2 Prioritisation of research portfolio

Empirical analysis has been done at three stages to suggest how research resources ought to be allocated in the Rainfed Agro-ecosystem. These are: (i) aggregate level, i.e. across production systems, (ii) production system level, i.e. across enterprises within rainfed rice production system, and (iii) project level.

Aggregate level priority-setting

The purpose of aggregate level research priority-setting is to provide some guiding principles for allocating research resources to different production systems. To prioritise different identified production systems in the Rainfed Agro-ecosystem (rainfed rice, cotton, sorghum, soybean, groundnut), three indicators were used. These were: (i) efficiency, (ii) equity and poverty, and (iii) sustainability. Depending upon their relevance at the ecosystem level, the weights to these indicators were assigned as 0.6 to efficiency, 0.1 to equity, and 0.3 to sustainability. The results of this analysis

suggested that about 38 per cent of the total available research resources should be allocated to the rainfed rice production system, followed by 21 per cent to sorghum and 19 per cent to groundnut production systems (Table 4.2). Cotton-based production system should receive 10 per cent resources, and soybean-based system 9 per cent

Priority-setting at production system level

The rainfed rice production system is broadly divided into two sub-systems according to the importance of animal husbandry and horticulture: (i) rainfed rice with fruits and vegetables, and (ii) rainfed rice with animal husbandry (ICRISAT, 1998). The results suggested that within rainfed rice production system, about 61 per cent resources should go to crops, followed by 24 per cent to fruits and vegetables, 12 per cent to dairy enterprises and 3 per cent to small ruminants. The composition of research resource allocation changes in two sub-production systems depending upon the importance of different activities (Table 4.3).

It will not be desirable to allocate all available research resources for crops (61 per cent) in rice production system to rice crop alone. It is relevant because there are some other crops also which are of economic importance to the farming community, and these should also receive some resources depending upon their significance in the production system. An exercise on research resource allocation across crops suggested that half of the total available research resources for rainfed rice system should go to rice research, and about 11 per cent to other crops (Table 4.4).

Rice research should receive a bulk of resources in rainfed rice production system. The crop is grown in diverse environment. According to the ecological distribution of rice, the research resources to lowland rice should be about 30 per cent of the total research resources available in rainfed rice ecosystem, 15 per cent to upland rice research and 5 per cent to deep water rice (Table 4.5).

Table 4.2. Research resource allocation (percentage) across production systems in the Rainfed Agro-ecosystem

Production system	Resource allocation I*	Resource allocation II**
Rice	38	38
Sorghum	21	20
Groundnut	19	21
Cotton	10	10
Soybean	9	8
Other	3	3

* weights as 0.60 for efficiency, 0.10 for equity/poverty, and 0.30 for sustainability issues; and
** weights as 0.40 for efficiency, 0.20 for equity/poverty, and 0.40 for sustainability issues.

Table 4.3. Research resource allocation (percentage) within rainfed rice production system

Activity	Rainfed rice with fruits and vegetables	Rainfed rice with animal husbandry	Aggregate allocation in rainfed ecosystem
Crop production	58	62	61
Fruits and vegetables	35	16	24
Dairy	5	18	12
Small ruminants	2	4	3

Prioritisation of constraints in rice production

Several abiotic and biotic factors limit rice production in different rice ecologies. It was reported that as high as 908 kg ha^{-1} rice yield is lost due to various constraints in the uplands (Widawsky and O'Toole, 1995). The corresponding figures for lowland and deep water rice were 678 kg ha^{-1} and 531 kg ha1, respectively. While drought was the most important constraint in low and upland areas, submergence and alkali soils were limiting rice production in deep water area. Other constraints, which limit rice production, are pests and diseases, weeds, nutrient deficiency (particularly of zinc and iron). Yield losses due to various constraints in different rice ecologies are listed in (Table 4.6). Importance of these constraints should form the basis for developing research project to improve rice productivity in different rice ecologies.

Table 4.4. Research resource allocation (percentage) to different crops in rainfed rice production system

Crop	Rainfed rice with fruits and vegetables	Rainfed rice with animal husbandry	Rainfed rice production system
Rice	52	49	50
Maize	2	1	1
Wheat	2	3	2
Pigeonpea	1	0	1
Rape and mustard	1	0	2
Sesamum	0	3	2
Groundnut	0	6	3

Table 4.5. Research resource allocation (percentage) to rice in different ecologies

Rice ecology	Sub-ecology *	Research resource allocation
Low land rice	Shallow water rice	20
	Intermediate water rice	10
Upland rice	Upland rice	15
Deep water rice	Semi-deep water rice Deep water rice	2

* Shallow water rice = 0-30 cm; intermediate water = 30-50 cm: semi-deep water - 50-100 cm; and deep water rice = >IOO cm.

Table 4.6. Yield losses due to technical constraints in eastern India

(kg ha^{-1})

Constraint	Upland rice	Lowland rice	Deep water rice
Drought	224	77	63
Diseases	104	138	97
Insect pests	84	87	82
Soil related problems	132	82	78
Weeds	18	86	70
Submergence/lodging	33	86	100
Birds	33	7	21
Rodents	130	15	20

Source: Widawski and O'Toolc (1996)

Prioritisation of research projects

Twenty research projects in different areas are submitted to NATP for funding. The total budget requirement from NATP of these projects is Rs. 211.09 million for the next five years (1998/99 to 2002/3). There is no need to prioritise research projects if the entire amount is available, all projects can be funded. Under funds scarcity scenario, there is a need for prioritisation depending upon , their relevance to meet the regional and national objectives. To prioritise these projects, five indicators were used in view of their contribution in meeting the socioeconomic and environmental objectives: (i) efficiency, (ii) household food security, (iii) gender issues, (iv) sustainability, and (v) crop diversification. Information on these aspects was collated from the Principal Investigators (Pis). All indicators, except efficiency, were assigned ranks ranging between 1-5 depending upon their contribution. Efficiency impact was measured by net present value (NPV) and internal rate of return (IRR). Two sets of weights were used to develop a composite index to prioritise research projects (Table 4.7).

Table 4.7. Weights used to prioritise research projects in rainfed rice production system

Indicator	Weight I	Weight II
Efficiency	0.50	0.50
Food security	Q.20	0.20
Equity/gender issues	0.10	0.05
Sustainability	0.10	0.15
Crop diversification	0.10	0.10

To compute NPV and IRR, data pertaining to yield and cost of cultivation of existing best technology and of proposed research were collected from the PIs. This data-set was supplemented by probability of success of developing the improved technology as a result of research initiative, expected adoption ceiling, and expected level of adoption. The information supplied by the Pis was discussed with some specialists, and some modifications were made based on their past experiences. More discussion was focussed on probability of success, which largely depends on the strength of research station in terms of facilities and human resources.

To compute NPV and IRR following assumptions were made:

- adoption of improved technologies as a result of research under NATP was considered up to 2020 AD with technology degeneration at a linear rate after reaching the ceiling level;
- 1997-98 was used as the base year for target domain of the improved technologies and output prices;
- target domain of the improved technologies was assumed to be the agroecological zone of the research station/center;
- economic surplus approach in a closed economy model was used to estimate total economic surplus, NPV and IRR;
- supply and demand elasticities of different commodities were taken from Kumar(1997).

The results of priority setting analysis are given in Table 4.8. Research projects are first prioritised purely on the basis of efficiency (that is 1.0 weight to the efficiency indicator). The top five projects generating highest economic surplus as a result of research success are addressing issues related to low yields, drought management, weed management, diseases in livestock, and nutrient deficiencies in livestock system. Next five projects are addressing issues related to integrated nutrient management (INM), soil degradation, integrated pest management (IPM), management of excess water, and INM in vertisols and alfisols.

In the next stage, efficiency indicator was complemented by food security, equity/gender issues, sustainability and crop diversification. The ranking of projects changed when all indicators of national and regional priorities were considered. Increasing yield levels and drought management retained the same priorities but the two projects dealing with livestock system (diseases and nutrient management) were ranked higher. It was due to their contribution towards sustainability and diversification. Similarly, project like restoration of degraded watersheds, which was ranked 16th with efficiency criteria moved to 8th position due to its expected contribution towards sustainability.

The prioritised research projects and cumulative research cost provide useful information for management decision. This suggests that in case available budget for rainfed rice production system is Rs. 150 million instead of Rs. 21 1.09 million, only top eleven projects should be supported, and remaining should be submitted elsewhere.

If all projects are supported by NATP, the budget distribution is as follows: 79 per cent for crop production activities, including natural resource management, diagnostic surveys and socioeconomic studies, 16 per cent for animal husbandry, and 5 per cent for horticulture research. This distribution is to be changed. To match the aggregate level priority setting across different enterprises, there is a need to shift research resources from crop production to horticulture research. The research portfolio will be largely biased in favor of crop production, including natural resources, diagnostic surveys and socioeconomic studies (about 80 per cent) and animal husbandry (20 per cent) in case only Rs. 150 million are available for rainfed rice production system. It reflects that research projects on horticulture are not addressing key issues. Therefore, the projects submitted on vegetables and fruits should address: (i) only those constraints which limit production, and (ii) increase target domain of technology generated as a result of research project. In fact, projects are lacking which characterise livestock and horticulture sector to identify major problems faced by the farmers to effectively include in their farming system. Similarly, research projects are also not submitted on issues related to equity and gender which are relevant for designing appropriate technologies and prescribing policy interventions. No project has been submitted to promote export of potential commodities from rainfed rice production system. Perhaps organic farming in rice may increase possibilities of exporting coarse rice from this region.

3.3 Prioritisation of research portfolio and research stations

Since most projects are in multi-institutional mode, an attempt has also been made to prioritise research stations on the basis of intensity of the problem, which are later linked with the research projects submitted under NATP. Cluster analysis was used to identify research stations according to the intensity of one or several problems. Aggregate level data for this analysis was used from the project on 'Sustainable Rainfed Agriculture Research and Development' (1CR1SAT, 1998), while information on meteorology and micro-level technical parameters was collated from various research studies and observatories. Following were the steps used to prioritise research stations according to the intensity of the problems and research projects:

- develop district level database on area and production of major crops, and other indicators, namely population, farm implements, irrigation, etc. for the period 1990-94;
- collate information on climatic and other variables (for example rainfall during 1990-94, normal rainfall, evapotranspiration, length of growing season, crop coefficient, critical soil moisture, water holding capacity, rooting depth of crops, etc.);
- information on spatial distribution of soil type and soil quality traits (for example available water, pH, EC, hard pan, etc);
- compute weekly water balance following Thornthwait and Mathur approach;
- estimate maximum rice yield in upland and lowland ecosystems using the FAO water balance model;

- identify problems in the district and list their attributes; Q develop a composite index of problem attributes by assigning appropriate weight to each attribute;
- employ cluster analysis to make different groups of districts according to the intensity of problem;
- rank districts according to top 33 per cent problems as high, next 33 per cent as medium, and remaining as low priority problems;
- relate the problem area with the research project, and select research station falling in that district;
- group research stations into three categories as high, medium and low priority stations depending upon the rank of the problem; and
- develop a matrix with prioritised research projects on one side, and prioritised research stations on the other.

Table 4.9 gives the matrix showing the prioritised research stations and research projects. Under limited budget situation, two options are possible: (i) reject all research projects below the earmarked total budget for rainfed rice production system, and implement them in all selected research stations, and (ii) delete low priority research stations from the research projects, and the saving from this should allow more research projects down the line. Which option will be more beneficial and cost effective will require some further analysis. This will depend upon the severity or intensity of production constraint, extent of target domain of the research project, and the cost of research in different research locations.

Table 4.8. Prioritisation of projects based on efficiency, food security, gender, sustainability and diversification criteria

Project	NPV (m Rs.)	IRR (%)	food security	Sustainability	Gender	Diversification	Composite Index	Rank* Efficiency	Rank* Composite	Research Cost (mRs.)	Cumulative Cost (m Rs)
Improve crop yield ceiling	25572	114	4	3	3	1	0.81	I	I	7.66	7.66
Rain water management for drought alleviation	11102	184	5	4	3	2	0.617	II	II	14.42	22.08
Control of parasitic diseases	7312	197	4	3	3	4	0.512	IV	III	14.41	36.49
Sustainable livestock production system	4714	98	4	4	3	4	0.482	IX	IV	16.28	52.77
Managing excess water	2533	125	4	5	3	4	0.459	VIII	V	7.94	60.71
Weed management	9666	190	3	3	3	1	0.448	III	VI	15.70	76.41
Soil quality and degradation	3404	252	4	5	3	2	0.436	VI	VI	3.71	80.12
Restoration of degraded watersheds	814	90	5	5	4	1	0.425	XV	VIII	3.96	84.08
IPM	3115	79	4	5	4	1	0.420	VII	IX	36.11	120.19
Crop management strategies to increase	98	46	4	5	3	4	0.411	XVIII	X	18.72	138.9!
CI											
Nutrient managemnet of hybrid rice	1599	141	5	2	2	1	0.361	XIII	XI	2.56	141.46
Vegetable based production system	1460	237	3	3	3	4	0.348	XIV	XII	9.48	150.94
INM in fish cultivation	1652	167	3	2	2	4	0.322	XII	XIII	4.05	154.99
Vegetable cultivation and storage	88	48	3	3	3	4	0.321	XX	XIV	2.84	157.82
INM in vertisols and alfisols	2163	197	3	4	2	1	0.312	X	X	2.75	160.57
Integrated plant nutrient management	4579	142	2	4	2	1	0309	V	XV	7.07	167.64
Bioinoculants	70	103	2	4	2	2	0.253	XVI	XVII	11.49	179.12
Appropriate inoculants	185	59	2	4	2	2	0.243	XVII	XVIII	11.33	190.45
Soil tillage guide	2146	109	2	3	2	1	0.24	XI	XIX	4.28	194.74
Impact of trtank irrigation	1133	183	1	2	1	2	0.16	XIX	XX	8.00	202.74

1. Ranked based on efficiency criteria;
2. Ranked based on composite index.

*

4. Research Gaps and Opportunities

Rainfed rice production system has considerable potential to increase agricultural production if'client-oriented' research is encouraged. The need is to list the available technologies, which are presently locked in the shelves of the laboratories, test them by involving farmers /under Institute-Village Linkage Program, and Technology Assessment and Refinement Programme, and then modify/refine them according to the needs of the farmers. Some of the possible improvements are listed below:

i) Natural resource management

- Large areas are prone to degradation, which needs rejuvenation with participatory forest management system. Important species like Alnus nepalensis (alder), Grewia optiva (bhimal), sal, tendu, etc. can be considered.
- Jhum cultivation is gradually phasing out, but still practiced on sloppy lands, which need soil conservation measures;
- Improve technologies dealing with advancing sowing of rainy season crop and crop establishment of post-rainy season crop to increase cropping intensity.

ii) Crop diversification

- Refine technologies for crop diversification in upland and lowland rice areas. This can be achieved by introducing horticultural crops, animal husbandry, etc.;
- Technology-led diversification towards horticulture on the lands having slope more than 30 per cent;
- Improved varieties of turmeric and ginger need to be introduced;
- Improved and farmer-friendly technologies to be developed in areas related to rice-cum-fish, rice-cum-brackish water fish and prawn culture, plantation crop-cum-fish, fish-cum-duck culture and fish-cum-pig culture;
- Improved varieties and management practices of mango, litchi and jackfruit need to be introduced.

Table 4.9. Project-wise prioritisation of research stations

Project*	High	Medium	Low
4.1	Aganpura, Madhopur, Jabalpur	Dumka, Keonjhar	Daisai, Basuli
3.2	Agwanpura, Jabalpur	Jagdalpur,	Jabalpur, Ambicapur, Raipur
11.1	Dumka	Palamu	Agwanpura, Raipur, Jagdalpur, Ambicapur
11.2	Palamu, Basuli	Madhopur	Agwanpura, Jagdalpur, Ambicapur
8.1	Mahisapat, Agwanpur, Chiplima, Ranital, Bhawanipatna	Madhopur, Raipur, Keonjhar	Ambicapur, Jabalpur
6.1	Ambicapur	Raipur, Jagdapur	Jabalpur
8.2	Keojhar (V F), Sundargarh (V F), Madhopur (F), Mahisapath (O P F), Raipur (O), Jagdalpur (Q), Ambikapur (OC)	G.Udaigiri (OF), Ranital (VF), Seniliguda (OF), Jabalpur (O), Ambicapur (P), Bhawanipur (VP), Chiplima (PF) Jagdalpur (V), Basuli (C), Raipur (O), Agawanpura (Q,	Dumka (V), Madhopur (CV), Basauli (P), Raipur (VF), Jagdalpur (PC), Keonjhar (O)
6.3	Palamu, Chiplima, G.Udaigiri, Sundergarh, Simliguda	Agwanpura, Dumka, Keonjhar	Ambicpur, Jabalpur
3.3	Jagdalpur, Chiplima, Ranital	Ambicapur, Agwanpura, Jabalpu	Raipur
2.1	Basuli (L), Ranital (UL), Agwanpura (UL), Jagdalpur (LL)	Jabalpur (UL), Jabalpur (UL), , Madhopur (LL), Ambicapur (LL),	Ambicapur (UL), Ranipur (LL UL)
1.2 (Seco)	Jabalpur, Agwanpura, Palamau	Dumka, Jagadapur, Keonjhar	G.Udaigiri, Mahasapat, Ranital
3.4	Raipur, Jagdalpur, Basauli	Madhopur	Ambikapur
2.3	Mahisapath, Simliguda, G. Udaigira, Keonjhar, Bhawanipatna, Sundargarh, Raipur, Ranital, Jabalpur	Madhopur	Dumka, Ambikapur
1.2 (Char)	Jabalpur, Agwanpura, Palamau	Dumka, Jagadapur, Keonjhar	G.Udaigiri, Mahasapat, Ranital
11.3	Agwanpura, Jabalpur Jagdalpur, Chiplima, Ranital	Ambicapur,	Raipur
5.1	Ranital	Aipur, Dumka, Madhopur, Agwanpura	Ambikapur
3.5	Raipur, G.Udaigiri, Simliguda, Jagdalpur, Sundergarh,	Keonjhar	Ambikapur
5.2	Jabalpur, G.Udaigiri, Simliguda, Bhawanipatna	Raipur, Jagdalpur, Keonjhar,	Ambikapur

* For title refer Table 4.1.

C: Crops OF: Other vegetables and fruits LL: Lowland
O: Other vegetables P: Post-harvest UL: Upland
F: Fruits V: Vegetables

iii) Characterisation

- Characterisation of livestock production system;
- Constraints and potentialities in horticulture-based system;
- Problems of and opportunities for farm women in agriculture and allied sector;
- Prospects of non-farm sector.

On the basis of above list, comments of referees and consultant, research gaps in each project are developed and listed in Table 4.10. Projects may be solicited in these areas. The Principal Investigators may be referred the research gaps to be addressed for achieving the desired research outputs, and meet the requirement ofNATP.

5. Issues for Discussion

The paper ranked the problem areas, research projects, and the research stations on the basis of local, regional and national objectives, and identified few research gaps. It is recommended that following issues may be given more attention during the discussion to achieve the desired objectives of research.

- Delineation of ecosystem and production systems;
- Strengths and weaknesses of research centers;
- Indicators for research priority-setting, and their weights;
- Inclusion of Brahamaputra Valley in rainfed rice production system or hill and mountain ecosystem.
- Future directions for identification and prioritisation of research programmes in other production systems.

Table 4.10. Project-wise research gaps

Project*	Research gaps
1.2 (Socio-economics)	Two issues of characterisation and socioeconomic aspects are being considered. Study areas for 1.1 (Socioeconomics and characterisation) should be same. Develop linkage between these two projects.
1.2 (Chara-cterisation)	Two issues of characterisation and socioeconomic aspects are being considered. Study areas for 1.1 (Socioeconomics and characterization) should be same. Develop linkage between these two projects
2.3	Better package of practices for the vegetables under cultivation, new introductions including mushroom, production of hybrid seeds,
3.2	Use of CIS for scaling up technology is missing Start research and development in new domains for hydrological database, supplementary irrigation along with ground water, pisciculture, etc.
3.3	Explicit application of technology developed foron-farm situations through identification of recommendation domain by G1S. Agencies involved for pisciculture.
3.4	Study should be undertaken in the watershed framework. Objectives should be revised in view of NATP needs (ex ante and ex post analysis and policies for improved water management), address conflicting issues in tank irrigation.
4.1	Objectives should match with the needs of disease resistance, initial vigour, aromatic rice, soil acidity, etc. Physiological observations should be a part of the project.
5.1	Lack of whole farm system approach within a watershed.
5.2	Project should be limited in few important biota, knowledge database should be prepared.
6.1	Revision of proposal is needed. Include identification of farmer friendly indicators, water quality aspect, and strategies to control land and water degradation.
6.3	Knowledge base accumulation on alternate land uses, cheap and cost effective ways of controlling land degradation. Linkages ot agencies should be included.
8.1	Forecasting information through weather and GIS integrated approach missing; biology of pests: proposal should be developed into three parts for work distribution: (i) weeds, (ii) insects, and (iii) diseases
8.2	ITK and IPM are not used in the exact form. Only the control of a pest is considered as IPM. Weeds are also not considered for pest management Work may be centered on the cheap method of control of economically important pests on a few important crops.
11.1	ITK is missing, should be linked with 1.3
11.2	Select proven technology foron-farm testing, whole farming system approach should be the basis for sustaining crop-livestock system linkages
11.3	Whole farm approach by linking crop, animal and water harvesting

* For title refer Table 4.1.

References

CRIDA (1998), Report on the ICAR-World Bank Project on Sustainable Rainfed Agriculture Research and Development: Institutional and technological issues in setting the research agenda (Module III). CRIDA, Hyderabad: Central Research Institute for the Dryland Agriculture.

ICRISAT (1998), Sustainable Rainfed Agriculture Research and Development project: Database development, typology construction, and economic policy analysis (Module I). ICRISAT, Patancheru: International Crops Research Institute for the Semi-Arid Tropics.

Kumar, P. (1997), Supply and Demand Projections. Indian Agricultural Research Institute, New Delhi.

Widawsky, D.A., O'Toole, J.C. (1996), Prioritizing the rice research agenda for eastern India: pp. 109-130. in Rice Research in Asia: Progress and Priorities, Evension, R.E., Herdt, R.W., and Hossain, M. (eds.), Wallingford, Oxon, UK: CAB International.

4.4 Programme

December 14, 1998

Session I: Research Priorities

Chairman: Dr. R. S. Paroda, Secretary, DARE and DG, ICAR

Rapporteur: Dr. Suresh Pal, NCAP

1000-1010	Welcome	Dr. Dayanatha Jha
1010-1025	Workshop background and objectives	Dr. G. L. Kaul
1025-1100	Rainfed rice production system: Characterisation and constraints	Dr. H.P. Singh/ Dr. K.P.R. Vittal
1100-1120	Tea	
1120-1200	Research priorities	Dr. P. K. Joshi
1200-1245	Discussion	
1245-1300	Chairman's remarks	Dr. R. S. Paroda
1300-1400	Lunch	

Session II: Research Gaps and Opportunities

Chairman: Dr. G. B. Singh, DDG (NRM), ICAR

Rapporteur: Dr. K. P. R. Vittal, CRIDA

1400-1420	Research gaps and opportunities	Dr. K.P.R. Vittal
1420-1440	Comments by the Chairman, SAP	Dr. J. S. Kanwar
1440-1515	Discussion on research issues in -Crop improvement -Crop management	
1515-1530	Tea	
1530-1615	Discussion on research issues in Livestock Horticulture	
1615-1630	Chairman's remarks	Dr. G. B. Singh

Session III: Research Prioritisation Approach

Chairman: Dr. J. S. Kanwar, Former DDG, ICRISAT

Rapporteur: Dr. P. K. Joshi, NCAP

1630-1700	Discussion on Indicators for priority-setting Weights used Inclusion of Brahmaputra valley	
1700-1720	Remarks by the Chairman	Dr. J. S. Kanwar
1720-1730	Vote of thanks	Dr. Suresh Pal

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List of Tables

Figures