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Acronyms and Abbreviations

AICRP	All India Coordinated Research Project
ACIAR	Australian Centre for International Agricultural Research
ARIS	Agricultural Research Information System
ARRTIS	Agriculture and Regional Research Technology Information System
ARS	Agricultural Research Service
ASRB	Agricultural Scientist Recruitment Board
BAR	Bureau of Agricultural Research
BRC	Budget and Research Committee
CACP	Commission for Agricultural Cost and Prices
CGIAR	Consultative Group for International Agricultural Research
CIPP	Components of Evaluation: context, inputs, processes and products
DARE	Department of Agricultural Research and Education
DARPS	Decentralised Agricultural Research Priority Setting
DENR	Department of Environment and Natural Resources
DOST	Department of Science and Technology
ERDB	Ecosystem Research and Development Bureau
ES&M	Economics, statistics and marketing
GIA	Grants-in-aid
GIS	Geographical Information System
GNP	Gross national product
GOI	Government of India
HYVs	High yielding varieties
IARCs	International Agricultural Research Centres
IARI	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
INFORM	Information for Agricultural Research Managers
IPM	Integrated Pest Management
IRDP	Integrated Research and Development Programme
IVLP	Institute-Village Linkage Programme
ISNAR	International Service for National Agricultural Research
LDC	Less developed countries
M&E	Monitoring and evaluation
MIS	Management Information System
MTP	Medium-term plan

MTRDP	Medium-term research and development plan
NAARM	National Academy of Agricultural Research Management
NARCC	National Agricultural Research Coordination Committee
NAREA	National Agricultural Research and Extension Agenda
NARP	National Agricultural Research Project
NARRDN	National Agricultural and Resources Research and Development Network
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NCAP	National Centre for Agricultural Economics and Policy Research
NGOs	Non-governmental organisations
PCARRD	Philippines Council for Agriculture, Forestry and Natural Resources Research and Development
PIU	Project Implementation Unit
PME	Prioritisation, monitoring and evaluation
PPI	Project planning and implementation
PRA	Participatory rural appraisal
R&D	Research and development
RAC	Research Advisory Committee
REIA	Research evaluation and impact assessment
RETRES	Research Information Storage and Retrieval System
RMIS	Research Management Information System
RPF	Research Project File
RPPAP	Research Prioritisation in Philippine Agricultural Project
RRS	Regional Research Stations
SARCC	State agriculture research coordination committee
SAUs	State Agricultural Universities
SCUs	State Colleges and Universities
SRC	Staff Research Council
STAND	Science and technology agenda for development
TQM	Total quality management
UGC	University Grants Commission
ZREAC	Zonal Research and Extension Advisory Committee

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Foreword

There has been significant advancement in conceptual and methodological aspects of agricultural research evaluation, both ex ante and ex post. However, their adaptation in research systems for improved planning and management has not been very successful. Part of this could be attributed to inadequate attention paid to structural and functional complexities of the system. These concerns and several others were given due consideration in designing broad framework of priority setting, monitoring and ex post evaluation (PME) mechanisms for Indian agricultural research system.

The PME mechanisms envisaged and implemented under the National Agricultural Technology Project have evolved through several interactions. The papers covered in this volume formed the basis for evolving these mechanisms and the approach to institutionalise them in the national agricultural research system. It is hoped that this volume will be useful in addressing some of the problems, which may arise during the implementation phase. The papers have also raised some methodological and institutional issues, which are expected to encourage debate and further research in this area.

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Editors

1 Agricultural Research Management Paradigms: Need for Objectivity and Transparency

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1. Background

Accelerating food production was the main challenge for agricultural scientists during 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 allocation of research resources and reasonable realisation of the objective.

The last decade has added complexities. Regional balance, sustainability, trade-technology links, demand shifts towards non-foodgrains, income growth for the poor, are few of the many new challenges confronting agricultural scientists today. With time, this complexity will grow further. On the other hand, public funds available for agricultural research are scarce and may shrink further. 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.

It is equally important that prioritised research programmes are earnestly implemented, closely monitored and evaluated for impacts. Present system of monitoring and evaluation (M&E) lacks objectivity and is not linked with evaluation of scientist, research programme or institute. As a result, M&E is neglected by scientists and research managers. This convention should break. An effective M&E mechanism should objectively monitor research progress against well defined milestones and targets and provide feedback to research planning and prioritisation.

Specifically, the following reasons necessitate institutionalisation of improved research prioritisation, monitoring and evaluation (PME) mechanisms in Indian national agricultural research system (NARS):

Research Prioritisation

- Resource constraints in public agricultural research system
- Need for demand-driven research agenda
- Complex goals involving trade-offs
- Increased private investment in agricultural research and development (R&D)
- Lack of screening of non-plan programmes

Monitoring and Evaluation

- No milestones and targeted tasks
- Wastage of research resources
- No yardstick for objective evaluation
- Duplication of research efforts
- Lack of 'teeth' in evaluation
- Poor links between M&E and incentive and reward system

Realising the need and complexities of PME process and improving cost effectiveness of technology generation, Indian NARS, particularly Indian Council of Agricultural Research (ICAR), is currently charting a futuristic research management strategy under the National Agricultural Technology Project (NATP). The new strategy envisages rationalisation of resource allocation based on prioritised research portfolio and strengthening M&E of research programmes. It is aimed to institutionalise PME process through integration with research management process at all levels in the NARS. The guiding principle is that PME process should be more objective, transparent and decentralised.

Institutionalisation of PME process is much more challenging in Indian NARS which is large in size and multi-institutional in structure. A sagacious approach would be to draw lessons from the national and global experiences wherein efforts to strengthen PME are in progress. Integration of these experiences in structural and socio-cultural contexts of Indian NARS would help evolve a simple and workable institutionalisation mechanism. With this objective, a workshop was jointly organised by ICAR and the World Bank on July 21-23, 1997. The workshop brought together scientists, research managers and management experts to discuss methodological and institutional aspects of PME. The following specific outputs were targeted from this workshop: (i) developing appropriate PME mechanisms, including methodology, (ii) evolving a strategy for institutionalisation of these mechanisms in the NARS and improving analytical capacity, and (iii) developing research management information system. The main technical input to this workshop was provided by leading experts in the area of PME and research managers through contributed papers.

This volume brings out selected papers of this workshop, which sharply focus on the theme. The papers are grouped and presented in three parts. Three papers in Part II deal with methodological issues in research prioritisation. Case studies on PME are presented in Part III, whereas Part IV contains the papers on institutionalisation issues. Finally, a synthesis of the main issues and workshop recommendations are given in Part V.

2 Priority Setting at the Programme and Project Levels: Methods and Processes

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1. Introduction

Many factors influence the effective utilisation of scarce research resources, including quality of scientists, incentive and reward systems for conducting good science, timely release of sufficient operating funds, and appropriate physical and managerial infrastructure. In addition, resource allocation across problems, commodities and regions within a research system must be consistent with national objectives, such as efficiency and equity goals. Many research programmes lack systematic and transparent mechanisms for allocating research resources (Ruttan, 1982). Rather resources are allocated by informal mechanisms, such as collective judgement or beliefs of individual scientists, historical precedent, as well as political pressures. In a world in which the public sector is being held accountable for the utilisation of increasingly scarce public funds, there is a strong case for using more systematic and objective approaches to allocate research resources.

Research resource allocation decisions are made at several levels. In this paper, I will simplify these levels into three main types of decisions:

1. Allocation at the macro-level, especially allocation across commodities and resource-based programmes within a national research system.
2. Allocation at the programme or sub-programme level, such as the share of resources going to varietal improvement or soil fertility management, or to research on a particular disease (sub-programme level).
3. Allocation at the project level, in which resources are assigned to specific time-bound experimental programmes.

Of course, these various levels are not mutually exclusive. A good priority-setting approach will allow information on national policy-objectives to flow downward, and information on researehable problems to flow from the bottom up to influence higher levels of priority setting.

Mechanisms are needed to reconcile these various flows of information and develop consistent priorities across levels.

Most attention in priority setting has focussed on level (1). For example, nearly all the World Bank projects over the past few years have supported some sort of macro priority setting. In this paper I focus my comments on levels (2) and (3), which have been neglected in many priority- setting exercises.

Priority setting is carried out by the application of particular methods and analytical approaches to systematically compile information and then organise it to rank research priorities. However, the process of setting research priorities (i.e., who does it, who participates and how) is as important as the selection of analytical approach. In this paper, I touch on both analytical methods as well as processes.

2. Methods for Priority Setting at the Programme and Project Levels

Although informal approaches to priority setting have often been very valuable, they suffer a number of weaknesses. First, they are often not systematic in laying out overall national objectives and how research can contribute to them. Second, in any collective exercise, some voices are louder than others, which tend to dominate the selection of priorities. Third and most importantly, in such exercises little effort is made to assemble and present quantitative information in ways that facilitate decision making. In particular, the major rationale for any allocation of research resources should be the potential contribution to productivity growth, and economic data needed to analyse this contribution are usually not explicitly considered. As a result, research resource allocation decisions tend to be based on historical precedent and may not take account of rapidly changing demands for both the commodity and type of technology.

Economic benefits of research are determined by the following five key parameters:

1. The expected increase in productivity per unit (per ha, tonne or animal), if the research is successful;
2. The probability of success of the research;
3. The number and value of units (ha, tonnes, or animals) for which the research can potentially be applied;
4. The expected adoption path; and
5. The cost of the research.

At the programme level, priority setting involves decisions about allocation of resources across (a) research problem areas (e.g., varietal improvement for particular niches, specific diseases, and crop management practices), (b) allocation of resources across agro-ecological zones, and (c) for each research problem area and agro-ecological zone, selection of specific projects for funding.

Priority setting by research problem area

Crop loss studies have often formed the basis for priority setting across problem areas - for example, the amount of resources that should be allocated to different pests may be guided by the relative yield losses to each pest. This approach has been most widely used in rice research in Asia (Evenson et al. (1996) for a volume of over 20 such studies) but is also used more generally in setting priorities for varietal improvement.

There is a vast literature on estimation of crop losses and the limitations of the approach. However, in general three approaches have been used.

1. Estimates of crop losses from controlled experiments by comparing yields in protected and unprotected plots. The major limitation of this approach is the cost of experimentation and the difficulty of extrapolating results across time and space.
2. Farmers' estimates of crop losses. These have the advantage of representing real farm situations. However, for some types of losses, farmers' subjective measurement may be misleading since losses may be non-obvious or losses may be overestimated. Farmers typically give high weight to recent catastrophic events even if they are rare events.
3. Estimates by research and extension workers by random inspection of fields in a given area. Specialists for a given pest will likely be in the best position to estimate losses of that pest and with training, extension workers can also provide reasonable estimates. In some cases, subjective estimates may be supplemented by objective measurement (e.g., weed density) that can be correlated with yield losses. On the other hand, scientists may not recognise problems as perceived by farmers.

In practice, some combination of the various approaches can be used. This was in fact the case with the series of studies reported by Evenson era/. (1996). Where estimates were available from different sources, they were usually reasonably consistent.

A useful check on crop loss estimates is to estimate yield gaps, especially the gap between actual yields and potential yields. This gap provides an upper estimate of yield losses. The gap between actual farmers' yields and realizable on-farm yields provides estimate of crop losses that might be reduced in the short to medium-term through research. Such a check is useful to force scientists to revisit estimates of crop losses until they are consistent with the estimated yield gaps.

Crop losses, of course, provide only the potential gains from research on different problem areas. Some problems may be more amenable to solution through agricultural research, and costs of research may vary by problem area. Therefore, to be effectively used in priority setting across problem areas, crop loss estimates should be combined with estimates of the cost of research to resolve the problem, the probability of success and the extent that the crop loss will be reduced by the research programme. This information is necessarily subjective and considerable caution is needed in making such estimates. In practice, such estimates can be elicited through well-designed questionnaires to specialists in the problem area or through collective judgements of scientists in small workshop settings (e.g., the Delphi method). Historical data on research progress in overcoming particular yield-limiting factors, can also often be a good basis for projecting ex ante research benefits.

Even when costs and likely payoffs to research are included, there are number of limitations to using crop loss studies in setting research priorities. In particular, yield losses are only one source of potential productivity gains. Other sources of productivity gains that are not usually accounted for in crop loss studies are:

1. Post-harvest losses in processing and storage;
2. Opportunities to increase productivity through increased cropping intensity;
3. Potential gains through improved product quality; and
4. Potential to increase productivity through reducing costs per ha (e.g., reduced tillage).

For these reasons, crop loss studies are most important in setting priorities for varietal improvement programmes, especially the relative priority to different pest problems.

Crop loss studies have been used in several situations in India. Widawsky and O'Toole (1996) provides detailed estimates of crop losses and expected economic benefits to conducting biotechnology research on various rice pests in India. The results were used to set research priorities for rice biotechnology research. Likewise, several studies on crop loss estimates and ex ante returns to rice research are included in the compendium on rice research priorities (Evenson et al., 1996). However, it is not clear how these results were incorporated into decision making on research resource allocation in the Indian rice research programme.

Priority setting across agro-ecological zones

Other papers in this workshop will provide detailed case studies of resource allocation across agro-ecological zones and I will only make a few comments with respect to the use of these approaches in India. Even simple congruency approach can provide valuable information on how research resources for a given research programme are being allocated to various zones. Jain and Byerlee (1999) used data on research on wheat varietal improvement to compute the allocation of wheat research resources in the All India Coordinated Wheat Research Programme in relation to the estimated value of wheat production. They used a two-step procedure to breakdown the allocation of resources:

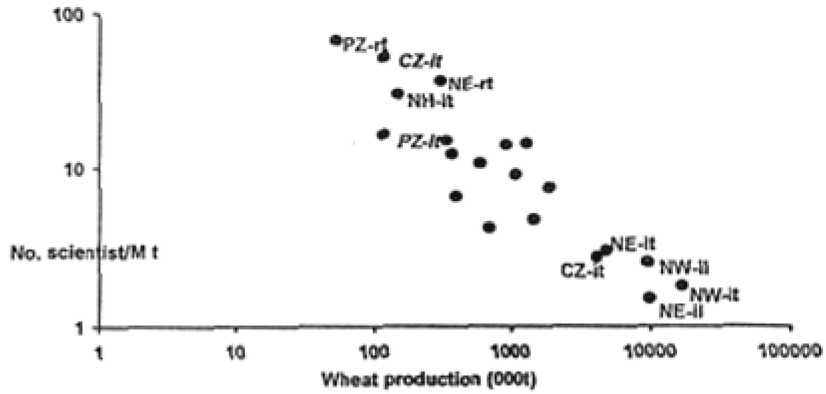
1. The cooperating scientists in the programme were allocated according to their location in a specific agro-ecological zone, and
2. within a zone, the allocation of resources to specific sub-programmes (rainfed, irrigated timely sown, and irrigated late sown) was estimated according to the number of experimental plots in each sub-programme.

This procedure indicated that research intensity (i.e., research resources per unit of wheat produced in the zone) varied substantially over sub-programmes and zones (Figure 2.1). In particular, research intensity is highly negatively correlated with the size of the mandate area for the research programme, indicating that research programmes for small wheat areas invest relatively more than those for large wheat areas.

While this type of congruency analysis can provide a good start to examine research resource allocation, it is limited by the fact that it does not take account of differences in expected rates of productivity gains and adoption in each zone or of the potential for spillovers across zones. In the present case, productivity gains and adoption rate were estimated from historical information from yield in varietal evaluation trials and varietal adoption statistics. This allowed the computation of an internal rate of return to research in each zone. Results shown in Figure 2.2, indicate substantially higher payoffs to some wheat research programmes than others, especially when spillovers across zones are considered. In fact, the results show that although the wheat research programme has been very productive overall, generating a rate of return in excess of 50 per cent, there are several programmes, mostly associated with small areas and marginal growing conditions, where payoffs have been low (Figure 2.2). In fact, 75 per cent of the benefits were generated by just two programmes in 1991. Historical rates of return are a good starting point for ex ante analysis of resources allocation. However, the research programme manager should ask why future gains might differ from historical gains.

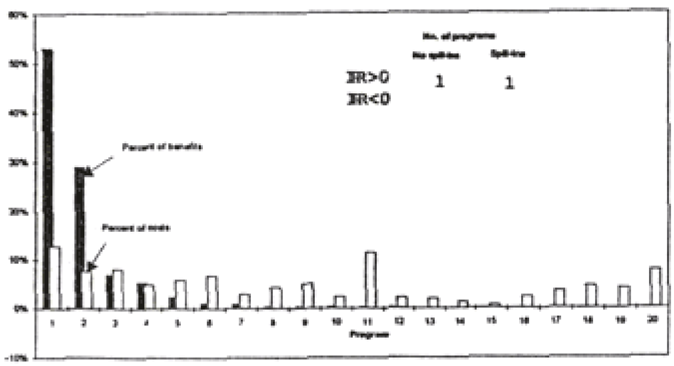
In allocating resources across zones, a major consideration is the potential for spillovers - that is, the potential for research conducted in one zone to be applied in another zone, either directly as a released technology or indirectly as an input into the research programme of other zones. Spillovers in agricultural research are now known to be very large. Often over half of the benefits of technology in a given zone are accounted for by spillovers from research conducted in another zone. Potential spillovers depend on agro-climatic similarity and socio-economic factors (e.g., grain preferences, institutional factors). In practice, potential spillovers may not be realised because of political and institutional barriers to the transfer of technologies across regions (Byerlee and Traxler, 1996). In a large country, such as India, the analysis of potential and actual spillovers should be a major part of research priority setting.

Figure 2.1: Number of scientists per million tonne of wheat in relation to size of environment in India (logarithmic scale)



Code: First two letters for zone, i=irrig., r=rainfed, t=timely planted, l=late planted, durum in italics

Figure 2.2: Per cent distribution of costs and benefits, Indian Wheat Research Programmes



Subsector methods for priority setting

While crop loss studies are narrowly focussed on estimating yield losses, in the subsector approach to priority setting, the entire industry from production, through processing, marketing, transportation and storage to consumption is considered. This allows broader considerations of processability, storability and consumer preference to influence production research priorities. The subsector approach also recognises that returns to the industry could be realised through upstream interventions in storage, marketing and processing.

This subsector approach has been most widely used at Michigan State University but elements of it have also been extensively used elsewhere (for examples, in Sri Lanka (Wettasinghe and Holler, 1996)). Typically, the approach goes beyond looking at production problems to quantify and analyse as far as possible the following:

1. Storage losses and interaction with product type and storage method,
2. processing methods and losses associated with each method,
3. marketing and transportation methods and losses, and
4. consumer preferences and willingness to trade-off product attributes.

Since product quality and type are often central to subsector studies, a special effort is made to measure consumer preferences. This may involve market surveys to estimate price premiums for different product qualities and put values on attributes of product quality. Once prices are known for a variety of product types, attributes of those products can be quantitatively related to prices to put values on particular traits (e.g., grain size or colour). For example, Unnevehr (1986) uses what economists call a heuristic model to value rice quality attributes in terms of grain colour, size, aroma, and percentage of brokens as a guide to consumers preferences for these attributes.

In recent work from Southern Africa where only white maize has been available in markets, economists have used contingency valuation techniques to measure consumers' willingness to pay for other types of maize such as yellow maize and dent maize (Rubey et al, 1997). Consumers were asked in a survey to choose between white and yellow maize at different price discounts for yellow maize. This approach differs from the heuristic method in the sense that the latter is based on actual preferences expressed in market prices, while contingency valuation estimates these preferences in situations where the product attribute under consideration is not in the market or where market prices are controlled.

The results of the maize work indicated that consumers, especially poor consumers, were willing to trade-off their preferences for white maize at relatively modest discounts. This had important implications for breeding priorities since yellow maize had not been emphasised despite a significant yield advantage.

Project selection within programmes

Various methods can be used to select specific projects for funding. In some cases, a simple checklist can be valuable in screening projects that adds an element of systematic objectivity to the process. For example, National Agricultural Technology Project (NATP) proposes to fund projects for production systems research that meet criteria such as relevance to local farming system constraints, use of a multidisciplinary approach, and likelihood of achieving results in the short term.

Checklists can be improved by introducing quantification of key variables to screen the list of potential projects. The quantification of variables is best done through a participatory process that involves scientists of various disciplines as well as farmers. For example, in priority setting for the rice-wheat work, the following variables were quantified wherever possible:

1. Area affected by the problem,
2. frequency of occurrence of the problem (number of years in ten years), and
3. potential for resolving the problem through research.

An important dimension of this work has been the definition of recommendation domains - groups of farmers who can use a similar technological recommendation. Failure to specify recommendation domains for a given research project is a major weakness of most research priority-setting exercises.

The identification of research problems and their potential solutions, can be facilitated by techniques such as problem-cause diagramming where problems are listed and then causes for problems are identified and mapped. The understanding of problems helps identify relevant solutions to those problems. Tripp and Woolley (1992) provide an excellent overview of the use of problem-cause diagram, development of quantifiable indicators to identify research priorities, and their translation into an experimental programme.

Economic analysis can also be applied at the project level to estimate ex ante cost-benefit ratios as a basis for selecting among projects. This method is being applied in some NARSs, and in Australia is a requirement for project submission for many funding agencies. At this stage in the development of analytical capacity in priority setting, the use of ex ante cost-benefit analysis at the project level should be approached cautiously since the resources need to undertake a quality analysis are considerable if the results are to be credible to scientists and funders. In addition, the success of a research project depends critically on its scientific merit as well as its relevance to solving real problems. Undue emphasis on ex ante economic analysis may detract from efforts in these areas, such as peer review and client interaction. Economic skills in most research programmes are scarce and the opportunity costs of employing them in economic analysis of projects relative to other activities (e.g., economic evaluation of technologies and diagnostic surveys) are high. At this stage in the state-of-the-art, economic analysis has not been shown to provide added value in selecting individual research projects.

Limitations

The above brief review of methods now available for research priority setting within programmes shows that there are an array of methods available that have been widely used and that are applicable in the Indian context. Nonetheless there are also limitations to these methods that should be considered.

- The impacts of some types of research are difficult to measure or value (e.g., basic research or research on natural resources management). However, checklists with quantifiable criteria can still be employed to set priorities for these types of research.
- Research is an inherently risky activity with very uncertain outcomes and considerable care is needed to make ex ante estimates. Where possible, data on historical impacts and peer reviews should be used to refine estimates of key parameters.
- The estimate of potential benefits is more difficult as one moves from adaptive research with near term payoffs to longer term strategic research. The emphasis on quantification of benefits should therefore be less in strategic research.
- The future will be different to the present, so that setting priorities based on the present situation may fail to foresee important changes in demand for new technologies. For this reason, mechanical exercises in priority setting are no substitute for vision.

3. Priority-Setting Processes: Participatory Approaches

Success in research planning and priority setting depends at least as much on the processes used in arriving at priorities as on the specific choice of analytical methods. Institutional processes for research planning generally include the following general steps: assessment of the external environment; assessment of the current status of the organisation; projection of desired future state of the organisation; analysis of the gap between existing and desired state; determination of a strategy to close the gap; formulation of an action plan; implementation of the action plan; monitoring and evaluation of implementation and outcomes; and adjustment to strategy and action plan, as appropriate (Collion and Kissi, 1995). A participatory approach to these steps that involves both other scientists as well as major beneficiaries and other stakeholders ensures not only the incorporation of relevant information and skills, but also helps build commitment to the final research plan.

Participatory processes involving scientists

Priority setting is not an "economists job". It is best carried out through the participation of scientists at two levels. First, a small task force of scientists working in the research area of interest should be charged with the job of leading the priority setting, rather than relying on a special planning unit to undertake the analysis. Second, the task force may call on a wide range of other scientists to provide information and estimates for specific parameters. In some cases, this can be done through small workshops and in others through written questionnaires. Participation of scientists can be facilitated by the use of methods such as the development of problem-cause diagrams and the ZOPP procedure developed by GTZ. The process needs to be iterative as parameter estimates are continually refined.

An example of this participatory approach is the setting of priorities for an agro-forestry research in Africa. There a task force was assigned to priority setting over a period of one year (Franzel et al., 1996). Similarly, the commodity priority setting undertaken by the Kenyan Agricultural Research Institute involved a task force for each commodity (Kamau et al., 1997).

Participatory processes involving beneficiaries

Major stakeholders should be involved as full partners at each step in the process in order to increase the quality of information used, develop strategy, and to build political support for the strategy (Ricks, 1997a). The major stakeholders are the expected beneficiaries of the research, but others such as policy makers, processors, and environmental groups may also be represented.

Stakeholders may be involved either passively or actively. In the passive approach typified by the diagnostic survey, stakeholders are consulted in problem identification and screening of potential solutions. Diagnostic surveys have been widely used to set priorities at the project level and provide an invaluable source of information in the priority-setting process.

Increasingly, more active processes are being tried in which stakeholders not only provide information but are engaged in decision making on research priorities. Farmers can be invited, for example, to be part of the priority-setting task force, or workshops can be held in which major stakeholders, such as representatives of farmer organisations are asked to make recommendations on research priorities. The Regional Meetings of the Indian Council of Agricultural Research (ICAR) are a step in this direction. The Research Corporations in Australia have also developed strategic plans for research based on involvement of a wide range of representatives of the industry and extensive consultations with other concerned groups.

In a fully participatory approach, priority setting is put entirely in the hands of major stakeholders. For example, the task force to undertake strategic planning for the Michigan apple industry was made up of representatives of the industry, including producers, processors, transporters, and consumers (Ricks, 1997b). The task force with the participation of a facilitator from the research system, had full responsibility for developing the strategic plan and its implementation. Such user empowerment is best undertaken in association with user funding of research.

4. Institutionalisation Issues

Although many research systems have engaged in strategic planning and priority setting, few have been able to institutionalise the capacity to undertake such planning on a continuing basis. Several reasons account for this:

- Strategic planning and priority setting have often been seen as being imposed from outside and in too many cases, plans have been developed by outside consultants with little in-house input.
- Too much attention has been placed on developing quantitative estimates of resource allocation, at the expense of analysis of broader science policy issues, such as the potential role of the private sector and its links to the public sector, federal-state division of research responsibilities, and the opportunity to import rather than develop new

technologies. As a result, despite the range of detail on the research system, most plans lack a vision for the future development of the whole technology system.

- Nearly all of the analysis of research priorities has been carried out at the macro-level to analyse priorities across programmes. However, research decisions are made operational at the project level and there has been no effective mechanism to move from the top-down programme planning to the bottom-up annual cycle of project formulation for funding. As a result, the funded projects in aggregate are often inconsistent with the established macro-level priorities.
- It has proven very difficult to make the hard decisions to reallocate staff and budgets in line with priorities, so that priority setting has often not been translated into practice.

Experiences of the past decade provide a number of lessons that can be applied in developing capacity in future priority-setting exercises:

- Analytical work to guide research planning is best undertaken from within the research system, preferably stimulated by a small unit with ready access to senior research managers and which is given a clear mandate to improve priority setting. The role of this unit is largely to facilitate the planning process rather than to undertake planning per se.
- Institutionalisation requires strong commitment by research managers to ensure that the results will be considered in decisions on research resource allocation and that, in fact, research resources shift in ways that are consistent with identified priorities.
- The process should be participatory including a wide cross section of scientists and the main stakeholders, policy makers, research partners and clients to ensure "ownership". At lower levels of planning and priority setting, participation of users should increase relative to participation of policy makers so that in the design and selection of research projects, the main interaction should be between scientists and farmers.
- The development of databases will be an integral part of institutionalisation. Databases may cover a variety of production and market information. It is critical also that a system be developed to track research allocation to ensure that research resources move in ways that are consistent with priorities, in fact, the starting point for priority setting should be estimation of current resource allocations.

5. Monitoring and Evaluation of Research Programmes

The other side of priority setting, is the monitoring and evaluation of research programmes and projects to ensure that they are implemented according to priorities, and that they have the expected impacts. Performance monitoring and evaluation (M&E) systems have two major functions: (a) to highlight research programme impacts on national policy objectives, and (b) to provide a basis for assessing progress and making needed adjustments to programmes and policies. Through monitoring (the routine collection of data on programme performance and programme adjustments to identify problems) and evaluation (the analysis of monitoring data and system performance), research leaders and administrators can track research performance against plans and provide feedback for needed revisions of plans and strategies. M&E also provides the basis for measuring accomplishments and determining the success of programme activities.

Progress towards the desired objectives is measured by various "indicators" of programme progress. Given difficulties of measurement, it may not be possible to quantify some programme outcomes, and qualitative or intangible indicators may have to be used. Table 2.1 provides a simple framework for thinking about an M&E system for agricultural research. Different types of indicators are applied at different frequencies at each level of a research system. Process indicators are largely for monitoring of individual research projects and are the building blocks for monitoring of overall progress in implementing an agreed research programme. Process indicators should be, as far as possible, quantified. A good practice is to require that research proposals include milestones that explicitly layout specific progress in implementation. A good example is provided by the milestone indicators required in projects funded by the Research and Development Corporations in Australia.

Indicators of research outputs are used for both monitoring and evaluation. These may be measured at both the project and programme level and will be somewhat different for basic and applied research. At the planning stage, both research projects and research programmes need to identify the expected outputs of the research as well as intended users or beneficiaries of the research results.

Finally, impact indicators are largely used for evaluation of research programmes. Impact indicators are rarely practical or necessary at the project level, but should be applied to the programme level at regular intervals, although, because of the long-run payoffs to much research, these intervals should usually not be less than five years. Impacts may be measured up to the system level, for example, through studies of economic returns to overall research investments (e.g., econometric estimates of research impacts on changes in total factor productivity).

Research funders sometimes call for even more in-depth impact evaluation of agricultural research on national policy objectives, such as food security or poverty alleviation. However, because of the multitude of factors influencing these objectives, this is more difficult to do in practice. !

In summary, the priority information requirements for M&E are:

- Within a programme, each project proposal should include a few simple monitorable milestones that quantify implementation progress as well as progress in achieving outputs. Progress against these milestones can then be measured in annual progress reports, perhaps supplemented by a very brief six monthly report.
- At the programme or institute level, each programme should define long run strategies and a five-year work plan which provides measurable indicators of implementation of the research programme and of research outputs. Performance against these indicators can then be measured on an annual basis as part of the annual reporting requirements of programme leaders.
- On a regular basis about once every five years, each programme should be subject to a comprehensive external review of technical aspects, and an analysis of its impacts.

All research organisations must have an institutional capacity for M&E and for feeding the results back into decision making. Building such a capacity requires only a modest investment and should be a priority for research organisations. The major problem experienced in M&E systems for research has been the tendency to collect too much information in a highly centralised and bureaucratic manner. To date, there are few examples of good practice in this area but the key elements of successful institutional capacity appear to be:

- Designing a simple system that minimises data collection to a few critical variables.
- Utilising a variety of mechanisms besides quantitative indicators as an integral part of M&E. These include planning and reporting workshops, field visits, external technical reviews of research programmes, and just walking around to observe laboratories and experiments.
- Decentralising the implementation as far as possible. For example, project monitoring should be decentralised to programme or sub-programme leaders.
- Establishing a very small unit to promote M&E, provide training and develop standards, but to undertake M&E only at the macro level.
- Ensuring that there are mechanisms for research managers to receive timely information from the M&E system and make corrective actions.
- Contracting some M&E activities, especially impact studies, to independent agencies or individuals.
- Developing a management information system (MIS) to monitor shifts in resource allocations over time in relation to the priorities. Without information on current resource allocations, it is impossible to know , the direction in which resources should be shifted, even after the formal priority-setting exercise is carried-out.

Table 2.1: Summary of M&E indicators and their implementation in agricultural research

Type of indicator	Example	Level at which applied	Frequency of implementation
Process Indicators for Monitoring Implementation Performance			
Inputs	Funds expended, scientist time used	Project level with aggregation to programmes, institutes and systems	Annually with six monthly update on progress
Outputs	Trials conducted, crosses made, surveys completed, etc.	Project level with aggregation to programmes, institutes and systems	Annually with six monthly update on progress
Impact Indicators for Monitoring and Evaluation of Research			
Research outcomes (for monitoring and evaluation)	Applied research Technologies developed, recommendations made, publications Basic and strategic research New research methods, tools techniques, hypotheses proven, publications	Project level and programme level with aggregation to institutes and system	On completion of a project (e.g., after 3 years) Annually at the programme level (e.g., annual report) More in-depth at fixed intervals (e.g., external reviews of programmes)
Research impacts (for evaluation)	Applied research Technology adoption, yield increases, cost reduction, economic return on research investment, impact on total factor productivity Basic and strategic research Utilisation of new knowledge to increase the efficiency and efficacy of applied research	Programme, institute and system level	Once every five years for each programme

6. Conclusion

At the programme level, research programmes need to develop capacity to conduct analysis of research priorities on an ongoing basis rather than as a one-off exercise. An important starting point is to develop a project information system to track current resource allocations and monitor shifts in resource allocation in accord with priorities. The use of more formal economic analysis in setting research priorities should be encouraged at the programme level and should be broadened to include non-commodity research. However, research managers must always ask what is the benefit-cost ratio of doing benefit-cost analysis of research projects. At this stage in the state-of-the-art, economic analysis has not been shown to provide added value in selecting individual research projects, since the resource requirements to undertake a quality analysis for a large number of projects is just too large.

Particular attention should be paid to processes for priority setting, and putting in place mechanisms to involve a wide range of scientists, beneficiaries and stakeholders in the process. Ultimately, the institutionalisation of such participatory mechanisms will be the key to successful priority setting for more effective research.

Another side of priority setting is M&E of research programmes and projects to track performance of research and provide feed back for needed revisions of plans and strategies. The progress should be measured against well defined indicators of process, input, output and impact assessment. All institutions should institutionalise this capacity in a simple and decentralised manner, which can ensure timely flow of information.

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3 Linkages Among Measurable Criteria and Sensitivity Analysis for Research Priority Setting: Learning from the Experiences of ICRISAT

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1. Introduction

The research priority-setting exercise conducted by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in the early 1990s was driven by a determination to build an objective and transparent basis for its medium term plan (MTP) for 1994-1998 (ICRISAT, 1992). Like other members of the Consultative Group on International Agricultural Research (CGIAR), it faced the challenge of a changing external environment where funds for research were declining, and therefore, a pursuit of a focused research agenda was imperative. This change motivated stronger accountability and a search for an objective research priority setting and resource allocation process. Significantly, it prompted awareness among scientists and research managers about the impact and payoff of research.

The ICRISAT developed a structured priority-setting strategy which aimed at reflecting its multiple research objectives. The determination of the priority research portfolio was built on an analytical priority-setting methodology where a composite index is derived from a set of measures established for each of the following criteria: economic efficiency or total welfare gain, equity or distribution of the total welfare gain, sustainability and internationality.

This paper first discusses the priority-setting criteria and their linkages. This is followed by a discussion on database development and prioritised research portfolio. The strengths and weaknesses of database are examined by assessing consistency in parameters used for priority setting across research programmes. The next section demonstrates usefulness of impact assessment data in priority-setting analysis. The paper finally summarises important implications for future research priority-setting framework.

2. Objectives and Measurable Criteria

The CGIAR mission statement reads: "Through international and related activities, and in partnership with national research systems, to contribute to sustainable improvements in ways that enhance nutrition and wellbeing, especially for low income people" (TAG Secretariat, 1992). This mission statement defines mandate of the CGIAR institutions. ICRISAT's geographic regional mandate is the semi-arid tropics, where the world's poorest and hungriest people live. The global crop mandate includes six food crops-sorghum, pearl millet, finger millet, groundnut, pigeonpea and chickpea-mainly grown by poor people in a harsh and undependable environment of the world.

The above mandate of the ICRISAT may be translated into a set of objectives which may be used as a set of criteria for priority setting, namely, improvement in economic welfare, equity, internationality and sustainability. The measurements used for each criterion (Kelly et a/., 1995 and Bantilan, 1994) are discussed below.

Welfare gains: Two measures are commonly used in the estimation of welfare gains from research. The first measure is to estimate the value of expected change in output due to research. The second measure is to estimate research benefits and their distributional consequences by applying the principle of economic surplus. Both the approaches use basic concepts of demand and supply to represent the production and consumption environment, but substantial differences may occur between these measures. Under uncertain demand and supply conditions, the first measure may substantially overestimate research benefits. Therefore, a good understanding of underlying production and consumption environments is important in choosing the appropriate measure and in interpreting the estimates (Davis and Turnbull, 1992).

In the ICRISAT MTP, the first measure was used due to data limitations. The expected annual value of yield gains which would be achieved should the research be successful was calculated for each research theme by using yield loss data and anticipated percentage yield improvement from research within the targeted research domain(s). This value was discounted according to probabilities of success, ceiling rates of adoption and time value (discounted cash flow) relating to expected research and adoption lags to generate the present value of benefits. An aggregation of all net present values over a specified time horizon for which benefits continue to accrue, provides the total benefits in net present value (NPV) terms.

Research costs were estimated for human capital cost, operational costs and value of capital items required. For each theme, the discounted value of principal scientists' cost and operational and capital costs were calculated for each year of the projected research time frame. The sum of these annual figures provides the total ICRISAT cost in present value terms.

Having computed the present value of total costs and total benefits, with adoption levels and probability of success taken into account, the net benefit-cost ratio was obtained by dividing the net benefits (total discounted benefits less the discounted costs) by the discounted cost. The internal rate of return was also calculated. The net benefit-cost ratio (NBCR) and internal rate of return (IRR) represent the efficiency of research investments.

Equity: The equity criteria represent the distributive effects of research investments. This measure should reflect the share of various sections of society (e.g., poor and non-poor; male and female; or urban and rural) in the total welfare gains. A distributional indicator may be obtained from the economic surplus measure cited above. This requires estimates of elasticities or the degree of responsiveness to prices of each specific sector benefiting from research. As elasticities are not readily available for some crops or for specific sector, analysts usually take a range of reasonable values based on characteristic of the crop and market structure. Alternatively, some proxy variables are identified to represent the distribution of welfare gains.

Two proxy variables were chosen for the ICRISAT research priority-setting exercise: (a) number of poor people; and (b) number of female illiterates. The first proxy counts the total number of poor people in the primary domain(s) for which research is targeted. The second proxy represents the number of female illiterates in the targeted research domain.

Internationality: The "internationality" criteria aim to capture the international public good dimension or research spillover benefits from an international agricultural research institution. The "internationality" of a research theme is considered significant when research is weighted towards projects of greater international impact, leaving purely national projects to the national agricultural research system (NARS). The Simposon index of diversity was used to measure the "internationality" of research theme.

$$I_i = 1 - \Sigma_J \{S_{ij}/100\}^2$$

where S_{ij} represents the share of total gains resulting from research theme i in country j. In this case, a higher factor indicates greater internationality. The index was chosen on the basis of its simplicity and ready availability of data on total yield gain for each research theme from the ICRISAT MTP database.

Data sets enabling estimation of actual international benefits and welfare spillovers have recently become available from various sources (Evenson, 1994; Maredia et al., 1994; Brennan, 1989). A systematic information system has been established to support research priority setting at the international level based on the welfare model where estimates of research spillovers across agro-ecological environments and across countries are established (Ryan and Davis, 1990). The database is available and the approach may be readily adapted to enhance the existing measure of internationality.

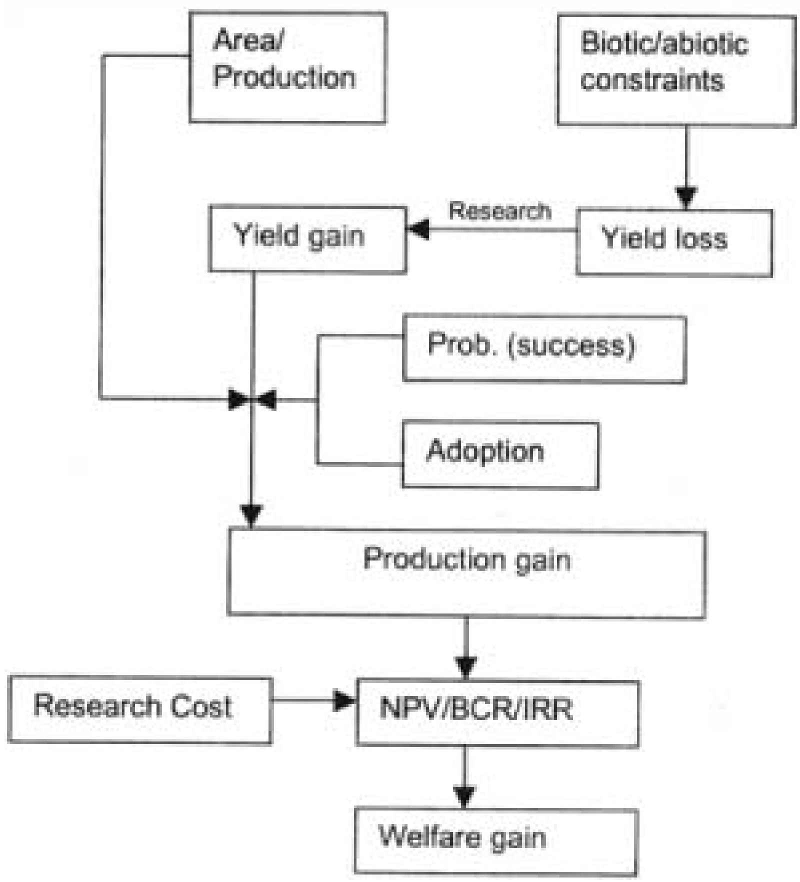
Environmental sustainability: Environmental sustainability scores were elicited from a multidisciplinary expert group among the ICRISAT scientists. The group was asked to assign ratings for each research theme that will indicate research theme's potential contribution to sustainable agriculture. The assignment of ratings is a way of delineating among alternative research options which are those likely to sustain the improved productivity of resource base (rating of 3) and which are likely not (rating of 1). It also identified those researches whose primary focus is to enhance the resource base (rating of 5).

Linkages among the measurable criteria and database for research evaluation

Figure 3.1 presents the relationship among the measurable criteria, viz. welfare gains, distribution of welfare gains (equity), internationality (research spillover effects) and sustainability. This figure shows the variables which underlie the measure of welfare gain. These are: (a) crop area and production; (b) yield losses due to biotic and abiotic constraints; and (c) expected yield gain due to research. The figure illustrates that the realisation of the expected production gain is subject to two conditions: (i) the probability that the research succeeds, and (ii) the resulting technology is adopted in farmers' fields. The resulting welfare gain due to research over a time horizon may be expressed in net present value (NPV) terms and measures of research efficiency (NBCR and IRR).

The link between total welfare gains and the distribution of these gains (equity) is demonstrated in Figure 3.2. The number of poor people and female illiterates serve as proxy variables to measure the distributional effects or equity. This is of interest as the ICRISAT targets the harsh and undependable environment of the semi-arid tropics to improve the welfare of poor people living in these areas.

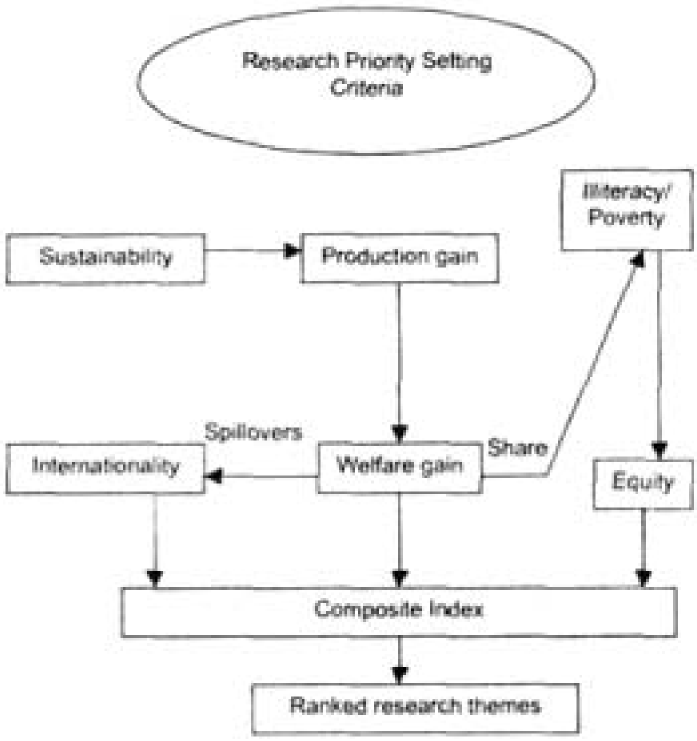
Figure 3.1: Basic parameters for measurement of welfare gains



The important link between environmental effects of technology and the level of production gains from research which ultimately determine the actual magnitude of total welfare gains over a specified time horizon is also shown. The score defined to measure environmental sustainability reflects the extent to which production gains are expected to be maintained over time as the use of the technology affects the natural resource base. The concept is illustrated by considering two alternative scenarios: (a) welfare gains are expected to be maintained over some period as the technology does not have adverse environmental effects or even enhances the resource base; and (b) welfare gains are not sustainable over time due to adverse effects of the technology on the resource base. Situation (a) illustrates cases where improved productivity is sustained over time so that welfare gains from research which accrue to society are maintained over time. Situation (b) presents the case where the improved productivity is not sustainable so that the benefits eventually decline with the deterioration in quality of the resource base. In this case, research-induced technological change, in fact, deteriorates the resource base, generating negative externalities, which neutralise or overweight the productivity gains.

A composite index, a weighted average of the four measures, is computed as a summary measure for setting priorities among alternative research options. The simulations discussed in this paper are derived using this index and linkages among the underlying variables.

Figure 3.2: Linkages among four priority setting criteria

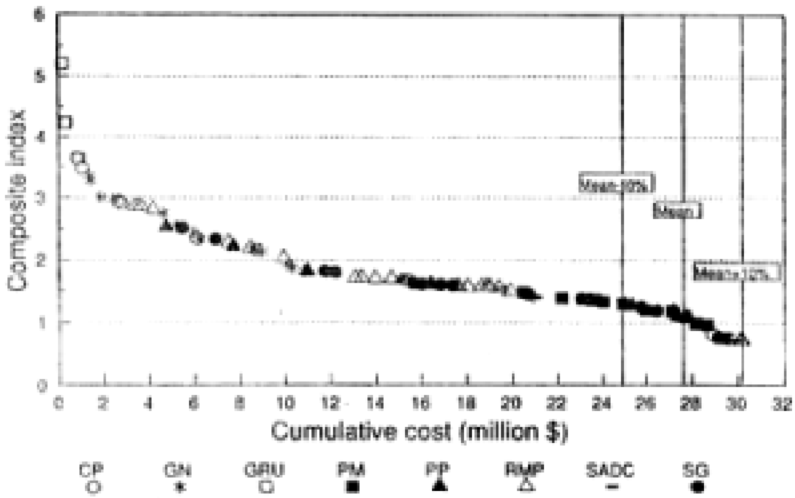


3. Structured Database and Research Portfolio

Systematic calculation of measures of the four criteria identified requires a structured database. The database developed from the medium-term planning process of the ICRISAT contains comprehensive information for each of the 110 themes (For details of prioritised research themes, see chapter 7 in this volume). The data variables include research objectives, target research domain, estimated yield losses, expected yield gains, probability of success, adoption rate and ceiling level, research and adoption lags, expected output, and manpower and capital requirements. This database serves as a benchmark or reference for research evaluation of future projects relating to the 110 research themes included in the 1994-1998 portfolio.

The prioritised research portfolio for the MTP 1994-98, representing the situation where efficiency, equity, sustainability and internationality are given equal weights, is taken as benchmark for this analysis. Figure 3.3 depicts the composite index-cumulative cost mapping of the 92 research themes slated for core funding in order of their priorities. The distinct mark assigned to each commodity or unit clearly shows the commodity/unit level distribution of priorities. The budget cut-offs indicated on the right hand side of these composite index-cumulative cost mapping explicitly show the number of themes affected in alternative budget scenarios. The figure clearly indicates that research themes relating to genetic resources (GRU) and groundnut (GN) are high priority themes, as they do not drop out in any of funding schemes. Resource management (RMP), chickpea (CP) and sorghum (SG) research themes lose at most only three themes each in a constrained funding situation; while a significant number of pigeon pea (PP) and pearl millet (PM) themes are expected to be dropped out in a constrained funding situation.

Figure 3.3: Cumulative cost vs composite index (based on benchmark for all themes)



Lack of consistency or bias?

This section examines the apparent lack of consistency in the data used to compute the composite index across research programmes. The generation of the data was a year-long iterative elicitation process where every scientist from all programmes of the institute was involved. To minimise the differences in judgement across programmes, the ICRISAT conducted a peer review of each programme (cereals, legumes, resource management and genetic resources) estimates; and the judgements are taken as the best available from the institute during that time.

The estimates of measurable criteria used in computation of the composite index (Table 3.1) were examined to identify the factors which account for priority ranking of themes. If lack of consistency is perceived in the elicited values underlying the priority rankings, then clarification of this issue may be attained by undertaking a comparative analysis of the MTP data provided by researchers across disciplines and programmes. Scrutiny of the efficiency parameters (area, expected yield improvement, probability of success, adoption ceiling and research cost) is facilitated by a comparison with their averages. This comparison aids examination of the comparability of estimates across disciplines and programmes and consistency with available secondary data.

As seen from Table 3.1, differences (among groups) in the estimates of probability of success, adoption ceiling and adoption lags are small. Estimates for the probability of success show that, on average, scientists from five research groups expect about 50 per cent likelihood of achieving research success. This means that the significant differences of the economic value of success (EVS) and net benefit-cost ratio (NBCR) among crops/groups are unlikely to be attributable to this variable. Similarly, comparative levels of the adoption ceiling for all groups are expected in the range of 30 per cent to 40 per cent. Pearl millet, pigeon pea and chickpea were above the average level of 34 per cent, while sorghum, groundnut and resource management fell below the average. The narrow range of the expected ceiling levels of adoption indicates the consistent conservative estimates that scientists were willing to provide with respect to the extent to which improved research outputs are expected to be adopted by farmers.

The variables of area, expected yield gains and research cost varied substantially across groups. The area estimates indicate that resource management, sorghum and groundnut are research themes that target the largest area, each covering more than 8 million ha globally, followed by pearl millet and chickpea covering 6-7 million ha each. The area given are based on researchers' target domains and are approximated based on existing crop area data or estimates of pest or disease (or other biotic/abiotic constraints) endemic areas. This comparative standing of the crop domains are confirmed by published data on global crop area (FAO, 1994). Expected yield gains and research costs are estimated more subjectively, and thus, require clearer justification. The yield gains expected by scientists indicate that a higher yield gain is expected from resource management than genetic enhancement research. The comparative standing of expected yield gains among mandate crops (i.e. higher for pearl millet and pigeon pea than groundnut, sorghum and chickpea), has a bearing on the claims with respect to genetic enhancement in these crops, and the difficulties of overcoming the major constraints facing production of some crops.

An examination of relative magnitude of research costs brings out that: (a) in spite of average to below average values for CP themes with respect to yield improvement, probability of success and adoption ceiling, significantly low research cost gave an NBCR that is three times the average NBCR across the groups; (b) small area coverage of the pigeon pea themes is similarly offset by the relatively low research cost estimate for this crop; (c) the GN themes fared better than the PM themes even as pearl millet promised a significantly higher expected yield gains, probability of success and adoption ceiling levels because the projected cost of GN research was almost half that of the projected cost of PM research; and (d) low NBCR rates for SG and RMP groups were primarily due to high projected research cost. Having been estimated subjectively, research cost variable requires a closer re-examination of estimates and a clearer justification for the extreme values.

An example of the required scrutiny is given for the case of chickpea. The data behind the estimates of the chickpea themes were re-examined by the legumes programme, and the original judgements on benefit-cost ratios were scrutinised. Much work has already been done on the themes relating to chickpea and therefore, probabilities of success were high, and on-going incremental costs were low. Two factors are identified to account for the above observation. These are: (1) number of scientists required to achieve the research objectives and hence the cost of research; and (2) market price. Technical information on research theme and output price differences account for the higher NBCR valuation for the chickpea themes.

Table 3.1 further illustrates relative position of commodity groups/research units ranked by the composite index and the five indices on which it is based (net benefit-cost ratio, poverty, gender, internationality and sustainability). The composite index explains the following priority ranking by commodity group/research units: (1) GRU; (2) GN; (3) CP; (4) RMP; (5) SG; (6) PP; and (7) PM. The relative positions of the commodity/unit groups with respect to the five measurable criteria explicitly clarify the basis of the priorities set in the MTP research portfolio. For example, the GRU group of themes stands out with clear advantage in all respects, i.e. NBCR, poverty, gender, internationality and sustainability. In spite of its low NBCR, groundnut-is ranked second as it gains advantage over the other five groups with respect to poverty, gender, internationality and sustainability.

Table 3.1: Value of parameters used in the composite index for priority ranking, ICRISAT MTP 1994-98

Parameter		Commodity group							Average
		GRU	GN	CP	RMP	SG	PP	PM	
1.	Efficiency								
	Area (m ha)	ne	8.0	6.2	12.3	11.5	2.5	6.9	8.2
	Yield improvement (%)	ne	7.2	6.1	12.8	6.0	9.3	10.0	8.2
	Prob. of success (%)	72	46	54	47	67	50	51	53
	Adoption ceiling (%)	ne	30	36	30	32	36	42	34
	Adoption lag (year)	6	5	6	4	7	5	6	6
	Economic value of success (m $)	54.2	119	122	438	117	116	58	146
	Research cost first year (m $)	0.14	0.27	0.22	0.37	0.42	0.22	0.52	0.33
	Net benefit-cost ratio	59.4	9.9	49.6	12.4	11.1	15.9	8.1	17.7
2.	Poverty (number of poor people, million)	397	188	77	86	77	101	36	111
3.	Gender (number of female illiterates, million)	378	205	120	93	84	149	62	129
4.	Internationality	1.0	0.67	0.36	0.51	0.69	0.15	0.46	0.53
5.	Sustainability	4.0	3.4	2.7	3.2	2.6	3.5	2.6	3.1
6.	Composite index	4.36	2.19	2.14	1.64	1.59	1.53	1.19	1.84

Shifts in priority sequence with changes in the weighting system

The final ICRISAT MTP research portfolio for 1994-1998 was derived by assuming that the four research priority criteria (NBCR, equity, internationality and sustainability) are equally important. This section examines the implications of deviations from this assumption on the research priority ranks. Clearly, the weighting system is a policy decision. Making transparent and explicit to research decision makers the actual trade-offs involved with respect to various weighing decisions is important.

The implications of the weighing system is examined by checking how the priority sequence shifts when the weights assigned to the priority setting criteria are changed. The composite indices were recalculated by assigning zero weight to one criteria at a time and equal weights to rest of the three criteria. The results indicate that there were no significant! changes in MTP priority ranking when each of the three criteria, viz. sustainability, internationality and equity is ignored in computing the composite index. The correlation coefficient between benchmark and revised composite indices was 0.95, 0.96 and 0.92, respectively. However, the priority sequence shifts substantially when zero weight is assigned to efficiency criteria (correlation coefficient 0.77). This means that the priority importation of each of the other three criteria is about the same, but the priorities implied by the efficiency criteria is different from the other three.

4. Conclusions and Implications for Future Priority-Setting Analysis

The ICRISAT developed a structured priority-setting strategy, which aimed at reflecting its multiple research objectives. The determination of the priority research portfolio was built on an analytical priority-setting methodology where a composite index is derived from a set of measures established for economic efficiency or total welfare gain, equity or distribution of the total welfare gain, sustainability and internationality. The strategy started with the development and extensive use of a rich data set pertaining to research objectives, estimated yield losses due to production constraints, expected yield gains achievable via research, probability of success, rates of adoption, adoption ceiling, research and adoption time lags for each of the 110 themes defined for the ICRISAT's research portfolio.

Five areas of consideration are important to improve the 1994-98 MTP criteria and measurements. The first is clarification of economic efficiency as a research objective. Reference to economic efficiency as a research objective raises the question of market failure and the implication that research is definitely correcting this market failure. Total welfare gains may present better criteria for priority setting as agricultural research is primarily an instrument to improve agricultural productivity. Thus, a measure is required to represent this, rather than representing the implied correction of market failures in agriculture. Measures of improvement in productivity or total welfare gains in agriculture, in terms of net present value or internal rate of return are suggested to be readily calculated using the data available from the 1994-98 MTP round.

The second area suggested for consideration relates to the two measures on which calculation of welfare gains from research have usually been based. The first measure estimates the expected change in output due to research and values of this change in terms of the current or expected commodity price. The second measure estimates research benefits by applying the principle of economic surplus to obtain the size and distributional consequence of improved technologies derived from agricultural research. While both approaches utilise the same basic concepts of demand and supply, a good understanding of the underlying production and consumption environment is called for in the process of choosing on appropriate measure. Substantial differences may occur between these measures and under uncertain demand and supply conditions, consideration of stability of estimates favour the use of the second measure.

The third area that needs further examination is the equity measure, representing distributive effects of research investments. This measure should reflect the share of the total welfare gains among various sectors of society, e.g., poor and non-poor; male and female; or urban and rural. The proxy variables chosen for the ICRISAT research priority-setting exercise are: (a) number of poor people, and (b) number of female illiterates. An analysis that can provide a convincing case that these proxy variables are in fact reflecting distributive effects is to take the welfare gain estimates and show that shares of these are distributed based on these two proxies.

The fourth aspect that may be improved is the measure for the internationality criteria. The Simpson index of diversity, by the definition used to measure internationality, applies on the share of production gains due to research accruing to different countries around the world. In this case, the share of total yield gain realised in a country is directly proportional to the production share of that country relative to total world production. An improvement of this measure is estimation of actual welfare spillovers which have been illustrated in the recent literature (Ryan and Davis, 1990). In these recent developments, research spillovers take into account the applicability of research related technologies beyond regions where the research was originally targeted. The international public good dimension of research is captured by taking into account the applicability of research across production environments and the production proportions of the defined production environments for each of the countries.

Improvement in the consideration of sustainability as criteria for research priority setting may be achieved by taking the conceptual scenarios of sustainable productivity effects explicitly in the measurement of welfare gains, where the ratings serve as a modifier of the computed welfare gain rather than as a separate independent criteria. An explicit identification of the overestimation or underestimation of welfare gains depending on whether or not and how these welfare gains are sustained over time may bring better consistency in the information generated to support research priority-setting decisions.

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4 Decentralised Agricultural Research Prioritisation

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1. Background

The Ninth Five Year Plan of Government of India has set a target of 4.5 per cent growth rate in agricultural sector. The long-term growth rate attained by Indian agriculture in the last five decades has been varyingly estimated between 2.5 and 3.0 per cent per year. This implies that the growth rate has to be stepped up by 60 to 80 per cent in the next five years. Although it is announced frequently that agriculture is receiving a high priority in the Ninth Plan, there may not be any appreciable increase in resource allocations to agriculture in real terms. Going by the allocations pattern in the Eighth Plan, there is no guarantee that even the modest levels of plan allocations will actually be realised in practice. It is well documented that the public investments, and consequently, the total investments in agriculture are dwindling in real terms. The net capital formation in agriculture still hovers around only ten per cent of the total net capital formed in the economy. Even to attain modest growth in the agricultural sector, all the agricultural resources are already stretched to their limits. While soil erosion takes place unabatedly, water is becoming scarce all over the country. While we still suffer from the illusion of a labour-surplus economy, there is already mounting evidence to suggest that the farmers are unable to attract agricultural labour at wage rates which they can pay. The gains from the green revolution are tapering off and there are no signs of a second green revolution ushering in. There are doubts in many quarters about the sustainability of agricultural growth even at the historical rate of less than three per cent, let alone the proposed rate of growth of 4.5 per cent per annum. With the prospects of expansion in cropped area being very dim, the onus of increasing production rests solely with the increase in productivity. In future, research and development efforts in agriculture are going to assume a more crucial and central role in agricultural development strategy than it ever had in the past.

Productivity of agricultural research and need for prioritisation

While the productivity of agricultural research at an aggregate level is quite satisfactory, one can easily detect the possibilities of making it much more productive at the level of research institutes and zonal research stations. Policy makers are now demanding a social audit of research stations as against the current practice of regular in-house evaluation and quinquennial reviews by external experts. As the resources allocated to agricultural research are getting scarce and the expectations from research are soaring higher, there is an imperative need to analyse and prioritise the allocation of research resources among the competing research programmes and projects. In the past, priority setting in agricultural research was a centralised activity. The whole process of setting research objectives and allocating research resources was highly subjective and followed a top-down approach. The National Agricultural Research Project (NARP) attempted to strengthen Regional Agricultural Research Stations and charged them with the responsibility of solving the location specific problems of a particular agro-climatic zone. Some interaction with extension workers and farmers was structured through the formation of Zonal Research and Extension Advisory Committee (ZREAC), joint diagnostic filed visits and training of subject matter specialists of the agricultural departments. The spirit of NARP was absorbed and implemented with varying degrees of commitment and compliance in different states. The experiments taken up at the Regional Research Stations and sub-stations have undergone some change and they were targeted to provide answers to the queries raised by farmers and extension workers. But many of them are more in the nature of simple trials rather than as integrated research projects. If the National Agricultural Technology Project (NATP) wishes to consolidate the gains made in NARP phase and further strengthen the location-specific research, the top-down approach followed hitherto for setting priorities need to be reversed.

2. DARPS Methodology

In 1994, a core team (The team consists of Drs K.P.C. Rao, S. Selvarajan, Suresh Pal, C. Ramasamy and S. Rajeswari.) was entrusted with the responsibility for the NATP to develop and test a Decentralised Agricultural Research Priority-Setting (DARPS) methodology at eight regional research stations in Maharashtra, Orissa and Punjab. This methodology is quite transparent, less data intensive, objective and decentralised. Decentralisation and delegation of power and accountability are vital to the success of this new approach. Support of top-management is equally important for implementing this approach. The various steps in DARPs methodology are mentioned here without elaboration.

1. Sensitisation of policy makers and research managers about the DARPS methodology.
2. Selection of a zonal research priority-setting team.
3. Planning of work schedule.
4. Analysis of secondary sources of information.
5. Participatory rural appraisal exercises in each farming situation.
6. Discussion with officials of line departments and scientists working in that agro-ecological zone.
7. Conducting a workshop for identifying the problems faced by farmers.
8. Seeking the help of expert panel members to short-list the problems of farmers which need solutions through research.
9. Analysing the root causes of major problems and selection of research hypotheses/approaches to solve them.
10. Discussion on the parameters assumed in the research projects proposed.
11. Calculation of net present values/benefit-cost ratios/internal rates of return for each individual research project.
12. Incorporating criteria other than efficiency/profit through the use of scoring model.
13. Matching of resource availability with resource requirements.
14. Selection of priority list of research projects and assessment of the need for additional resources.
15. Institutionalisation of DARPS methodology.

3. Institutionalisation of Capacity

The team tested the above methodology at four Regional Agricultural Research Stations in Maharashtra and two each in Orissa and Punjab. It was only to demonstrate the utility of a methodology which is objective, transparent and participatory to develop a medium term research agenda for that agro-ecological zone. Ideally, the priority-setting exercises should be carried-out at each of the Regional Agricultural Research Stations. The zonal research priority-setting team may consist of a social scientist, an agro-biological scientist and another scientist, whose discipline is of critical importance in that agro-ecological zone. There should be one member common to the zonal research priority-setting teams in all the zones and (s)he should preferably be from the headquarters of the agricultural university. This common member is needed to ensure uniformity in application of the procedure of DARPS methodology. (S)he is also needed to avoid too much of duplication in the research work carried out at different agro-climatic zones. Once the results of different zones are available, a lot of rationalisation is required particularly with respect to allocation of additional resources and shifting some scientists to the places where they are needed the most. In view of the important

functions to be performed by the common member, (s)he may be designated as the Research Policy Analyst of the agricultural university and placed at the level of an additional director of research working very closely with the Director of Research/Vice-Chancellor. (S)he may be drawn from the social sciences stream, preferably from agricultural economics. An agricultural economist can appreciate and implement DARPS procedure better than others as it involves application of economic principles and concepts. Under the NARP, a monitoring and evaluation cell is located in each agricultural university. It was expected that an agricultural economist will head this unit but there are a few universities where this cell is headed by non-economist. These cells are performing the monitoring duties, but not so much the evaluation duties. A proper evaluation can yield vital information with the help of which research managers can decide on priorities and allocation of resources. In fact, prioritisation, monitoring and evaluation should be the duties of the same cell. The existing monitoring and evaluation cells may be converted as the offices of the research policy analysts. In order to emphasise the critical role of these offices, the status of the head of these cells may be enhanced to that of an additional director of research. They should be strengthened with adequate staff, funds and latest information processing facilities. These cells can aid the directors of research and vice-chancellors in taking judicious decisions about priorities and closure of projects. It is a common knowledge that projects are continued even when they are not yielding any results or showing any direction.

4. Prioritisation and Empowerment of Scientists

When scientists propose new research projects, they often overestimate expected research impact. One of the reasons to these tall claims can be the desire to secure control over more resources. Quite often the research projects proposed by the scientists are based on review of literature, intellectual curiosity, continuation of past work and their perception of reality. When these projects are submitted for peer review, the reviewing scientists let them pass without subjecting them to a critical ex ante evaluation. When these research proposals go to people higher up in the ladder, their own subjective preferences determine the acceptance or rejection of the proposals. Many of the research results emanating from these projects do not translate into viable technologies as they were not relevant to farmers' problems. Many recommendations of research stations are not adopted by the farmers. At the same time, several problems faced by the farmers were not even addressed by the scientists through their research work. The DARPS methodology helps the research workers to follow a bottom-up approach of research planning and to take up projects that are quite relevant to farmers' felt needs and resource endowments. A scientist is facilitated to think about the possible impact the research project may have and the likely parameters of the adoption behaviour of the farmers. The optimism and exaggerated claims get moderated in the deliberations of the expert panel, which would have a group of peers. The scientists would learn to reflect on the resources needed and the benefits that can accrue from the research projects they take up. They get an opportunity to compare their research projects with those of others using the common touchstones of costs and benefits and this would lead to the generation of a shared research agenda in a participatory mode. This formal method of setting priorities and selecting the bunch of research projects which would have the highest impact in an ex ante sense, can certainly improve the research productivity. This methodology also helps assessing the additional requirement of funds, manpower, equipment and training needs to facilitate the successful completion of research projects. It creates an obligation on the part of research managers to provide the resources needed and leave the execution to the project leaders, except for the periodic monitoring provided for in the research projects. It tries to delegate the power and authority needed to execute the research project to project leaders, and at the same time fixes the responsibility on them for the completion of the project. This kind of decentralisation in decision making, empowering of scientists through delegation and building a pressure of accountability on them would help taking science forward to the farmers in the form of well-researched and well-tested technologies.

5. Performance Appraisal of Scientists

One should not expect that the research projects will be executed exactly in the same fashion as they are planned. Nor is it reasonable to expect that every project would be successful in generating the expected research outputs. But one can assess the reasons and justification behind the departure from planned courses of action and divergence between the expected and the realised research outputs. Therefore, the process of research should receive as much emphasis as the products of research. For this, an objective research monitoring and evaluation mechanism should be in place. The monitoring and evaluation of research projects may be taken up by the zonal research priority setting team at the level of Regional Agricultural Research Station under the guidance of the Associate Director of Research. At the university level, these functions may be coordinated by the research policy analyst under the overall leadership of the Director of Research and the Vice-Chancellor. Monitoring exercises may be carried out once in six months. Evaluation of the research projects may be carried out two years after their start, which is the appropriate stage to decide whether to continue the projects or not. A third alternative may be to redesign the projects in the light of the results obtained and re-assessment of the priorities. Priority-setting exercises may be repeated once in five years. Monitoring and evaluation linked to performance appraisal of scientists may be carried-out continuously to sharpen the research focus on problems confronting the farmers. These suggestions are intended to make the research process dynamic and responsive to emerging needs. The decentralisation of priority-setting process, effective monitoring and linking appraisal of scientists with their research work are expected to build accountability into the system and to make research more productive.

6. Limitations of DARPS Methodology

The DARPS methodology combines scoring model with economic surplus approach to arrive at a priority list of research projects. Economic surplus approach facilitates ranking of different research projects under consideration based on the efficiency criterion. Scoring technique incorporates non-efficiency criteria such as the likely impacts of research projects on sustainability, equity, employment, exports, etc. A weighting scheme selected by the expert panel can be used to combine multiple criteria to arrive at an overall ranking of the research projects. Economic surplus approach is quite helpful in dealing with research projects having a commodity focus. Although the assumptions made about probability of success, research impact and adoption behaviour are often exaggerated and questionable, they can still provide an approximate idea of the benefits that are expected to accrue from the technologies resulting from the research projects. In the absence of reliable estimates of supply and demand elasticities, it is not often possible to apportion the benefits between producers and consumers. Despite all these deficiencies, commodity-focused research projects can be evaluated using economic surplus approach. Research projects aimed at techniques and practices that would improve the management of resources are even less amenable to cost-benefit analysis. It is even more difficult to convert the research results from social science research projects into benefits. Even when these projects identify clear policy implications and recommendations, their value is contingent upon the acceptance and implementation of the recommendations by the policy makers. Same is the case with the projects aimed at the preservation of germplasm or biodiversity. While resource management, germplasm conservation and social sciences research are all important components of commodity research, it is difficult to put values on the benefits they can yield. One of the ways out is to treat them as predetermined activities and allocate a certain proportion of research resources to them, say 20 or 25 per cent. Only the remaining resources may be allocated to commodity-oriented research using economic surplus approach. The other limitation of the DARPS methodology is that it is not entirely objective. While it seeks to replace the present practice of totally subjective and centralised priority setting, it itself is not bereft of subjectivity. At different stages of the procedure, there is a scope of subjectivity creeping in, although it is sought to minimise by involving a number of persons. Because of its decentralised and participatory nature, it is likely to gain the support of the scientific community.

5 Institutionalising Agricultural Research Priority Setting, Monitoring and Evaluation: The PCARRD Experience

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1. Introduction

Priority setting, monitoring and evaluation (PME) are indispensable activities in the management of agricultural research system. These activities to a greater extent impact on research productivity, efficiency and effectiveness. The need for PME is increasingly felt because of scarcity of research and development (R&D) resources, and the growing consciousness of taxpayers over government spending. Because of these twin concerns, R&D system owes it to the public to continually search and develop better and innovative ways to strengthen PME activities.

The creation of the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, PCARRD in brief, (formerly Philippine Council for Agricultural Research) in 1972 was, to a large extent, inspired by the Indian model. This paper provides insights on how PCARRD created and strengthened its capacity in PME, rather than offering prescriptions for Indian Council of Agricultural Research (ICAR) or any other system. This will be done by enumerating the steps it has taken in terms of policies, strategies and activities related to PME.

As an overview, the Philippine economy and agriculture will be described as well as the Philippine National Agricultural Research System (NARS) to situate the paper in the context of this workshop.

The Philippines

The Philippines is an archipelago of 7,100 islands on the western rim of the Pacific and stretches about 1,851 km north to south between Taiwan and Borneo. The Population of the Philippines in 1994 was about 67.04 million with 45 percent residing in urban areas and 55 percent in rural areas. Population density was 223 person/sq. km. and population growth rate was 2.35 percent per year between 1980 and 1990 (Philippine Statistical Yearbook*,* 1994).

Agriculture is a major contributor to the Philippine economy. It accounted for 30 per cent of the gross domestic product in 1986, and 21 per cent in 1990. The agricultural sector supports nearly one-half of the population and is the main source of income and employment to the country's economically active population of 24 million people. In terms of area about 26 per cent (or 7.8 million ha) of the total land area of 30 million ha is under cultivation.

The Philippine agricultural sector (comprising crops, livestock and poultry, fishery and forestry) performed remarkably well during 1965-80. It posted high agricultural growth rate of 4.6 per cent, which slowed down to 1 per cent during 1980-90. Currently the Philippine agricultural sector is snowing signs of robust growth and dynamism. This productivity growth in Philippine agriculture is largely induced by research-generated technological advances (Dar, 1996).

2. The Philippine NARS

Two basic structures comprise the Philippine agriculture and resources system, a planning and coordinating body which is the PCARRD and a network of research centres and stations, the National Agriculture and Resources Research and Development Network (NARRDN).

The PCARRD is a planning and coordinating council for agricultural and forestry sector under the Department of Science and Technology (DOST). The DOST provides the direction, leadership, and coordination of scientific and technological activities in the country.

The PCARRD is mandated to (i) formulate strategies, policies, plans and programmes for science and technology development in agriculture, forestry and natural resources, (ii) programme and allocate government and external funds for R&D, (iii) monitor R&D projects, and (iv) generate external funds.

Organisational structure of PCARRD

The PCARRD has four main organisational components: the Governing Council, the Technical Advisory Committee, the Technology Transfer Advisory Committee, and the Secretariat. With this organisational setup, PCARRD involves a whole range of research, education, development, and policy making entities concerned with the national and regional development. Moreover, it brings together the expertise of policy makers, scientists, educationists, extension workers and entrepreneurs/ producers both from the government and private sector to find solutions to the problem of farmers and other end-users of technology.

The national agriculture and resources research and development network

The NARRDN network is composed of R&D centres/stations of the agencies such as the Department of Agriculture, Department of Environment and Natural Resources (DENR), state colleges and universities (SCUs) and private agencies/institutions. These agencies are independent of PCARRD but their R&D activities on crops, livestock, forestry, agricultural resources and socio-economics are coordinated, monitored, and evaluated by the PCARRD. Member-agencies in the NARRDN are: (a) 4 national multi-commodity R&D centers, (b) 7 national single-commodity R&D centers, (c) 23 regional R&D centers, (d) 88 cooperating stations, and (e) 9 specialized agencies.

Regional R&D consortia

This arrangement was implemented to build-up regional capability for research management and to optimise use of regular R&D resources through sharing. Composed of regional R&D agencies, the consortia plan, monitor and evaluate R&D activities in the region.

3. PME Institutionalisation Strategies in Philippine NARS

The Philippine NARS followed eight strategies for the institutionalisation process: (i) employment of a number of approaches in priority setting, (ii) formulation and implementation of medium-term R&D plan, (iii) research prioritisation in Philippine agriculture project, (iv) decentralisation of PME to the regions, (v) development of computer-assisted information system, (vi) focusing of grants-in-aid funds, (vii) manualisation of procedures, and (viii) holding of regular consultation.

Multiplicity of priority-setting approaches

In the early years of PCARRD, commodities were originally grouped into priority levels, i.e., Priority I, Priority II and Priority III. Priority I gets 80 per cent of the R&D budget, Priority II 10 per cent and Priority III, 3 per cent. Socio-economics and emergency projects were not included in the priority ranking but were allocated 7 per cent of the research budget. Priority setting relies heavily on consultations where participants identify a set of criteria to rank their priorities (Bantilan *et* a/., 1991). These criteria were as follows:

- Actual/potential contribution to value added
- Relevance to the socio-economic programmes of the government
- Contribution to improved policy formulation and implementation
- Linkages/support to other commodities
- Effects on the ecosystem
- Contribution to employment
- Contribution to improvement in labour productivity
- Availability of research manpower and facilities
- Unavailability of appropriate technology
- Contribution to efficient utilisation of resources

In 1984, priorities were regrouped according to Priority I (14 major research programmes), Priority II (integrated commodity R&D programmes), and Priority III (those not in Priority I and Priority II).

In 1988, another system of prioritisation was introduced following the creation of research bureaux each for the Department of Agriculture (DA) and DENR in 1987; Bureau of Agricultural Research (BAR) and Ecosystems Research and Development Bureau (ERDB).

Dubbed as the National Agricultural Research and Extension Agenda (NAREA), priorities were established at four levels: (i) priority development zone, (ii) priority development sector under each zone, (iii) priority commodity under each sector, and (iv) priority problem area under each commodity. A similar approach was used by DENR. Priorities were established at three levels: (i) priority ecosystem, (ii) priority commodity under each ecosystem, and (iii) priority problem area under each commodity. Both the systems hope to correct the imbalances in R&D among zones or ecosystems. Similar to the PCARRD prioritisation, priorities were determined through multi-sectoral and multi-disciplinary consultations up to the regional level, using scoring model to rank priorities. In the simple scoring process, alternative research activities were ranked by assigning relative weights to the various criteria used in the prioritisation. The criteria and weights used in ranking were subjective because the participants in the consultation were asked to use their own perceptions.

In 1992, when the Science and Technology Agenda for National Development (STAND) was formulated, PCARRD priorities were grouped in the following four categories:

i. **The export winners:** These are list of products and services which have to have a high potential in capturing substantial market share. These are to form the vanguard of an export drive.
ii. **The basic domestic needs:** These are list of products and services deemed necessary to sustain a productive population and provide infrastructure. The 19 priority provinces under the' President's Council for Countryside Development shall be the immediate focus of the project.
iii. **The support industries:** These industries are crucial to the development of both export and the domestic markets. These include packaging, metals and chemicals.
iv. **The coconut industry:** Special attention is suggested for revitalising the coconut industry as three million hectares of arable land are planted with coconut and one-third of the population depends on it directly or indirectly.

The selection of the products and services was based on the criteria derived from the ones used by the Department of Agriculture, Department of Trade and Industry and DOST. The following criteria evolved from consultations with the above mentioned departments and the private sector:

i. **Market Considerations:** High export performance, high export potential and world market demand, capability to sustain quality and supply, and self-sufficiency in the domestic market.
ii. **Technology Factors:** High value-added, availability of and access to superior technology, extensive backward linkages, abundant raw materials, and environmentally sound.
iii. **Human resource considerations:** Presence of highly skilled labour, presence of technical support personnel, potential for employment generation, and manpower skills development.

A consultative process was followed in arriving the STAND. A series of meetings were organised since October 1992 involving DOST officials and researchers, private sector representatives, government agencies, educationists and NGOs. A large Multi-sectoral Forum on Science and Technology was held in January 1993, during which various ideas on STAND were received. These ideas were processed by DOST, together with the chairpersons of the 10 workshop groups of the Multi-sectoral Forum. The draft STAND was then submitted to, and approved by the Science and Technology Coordinating Council (STCC) in February 1993.

The basic references in improving the list of priorities in science and technology consist of:

(i) National development goals

- Export level of US$ 23 billion by year 2000
- Per capita GNP of at least US$1,000/ year
- Reduce poverty incidence to 30 per cent or below

(ii) Sectoral development goals

- Increased agricultural productivity through modernisation diversification, countryside industrialisation
- Conservation and ,rejuvenation of natural resources
- Development and utilisation of superior technologies to a level of competitive advantage
- Regional and local development goals

Medium-term research and development plan (MTRDP)

The MTRDP represents the translation of STAND into an operational plan and will serve as basis for monitoring and evaluating the contribution of agricultural R&D sector to the attainment of sectoral goals in agriculture, environment and natural resources and science and technology. The MTRDP outlines the vision for agricultural R&D, goals, the subject matter priorities, and the strategies for attaining set goals. The Plan envisions an agri-industrialised Philippines sustained by science and technology through acquisition, generation, promotion and application of knowledge, information and technologies in agriculture, natural resources and environment.

This vision or goal is operationalised through the packaging of integrated research and development programmes (IRDP) which consolidates all the R&D interventions needed for the priority list of commodities and products. The IRDP serves as a guide in subsequent monitoring and evaluation activities, both at the national and regional levels. An IRDP is packaged for each priority commodity.

4. Research Prioritisation in Philippine Agricultural Project (RPPAP)

In the Philippine NARS, priority setting was largely consultative type with the help of scoring model. Bantilan et al. (1991) described this process as: "highly subjective in nature, requiring a good understanding and knowledge of national development goals and policies. Decisions are based on judgements provided by scientists as well or upper-level administrators regarding the serenity of particular types of research problems and as a general feel for what is possible to achieve via research". This has been the practice since the PCARRD was created in 1972 and until this time, except an attempt to use the principle of economic surplus in 1989 through the three-year project.

This project was implemented by the University of Philippines (Los Banos) in collaboration with the PCARRD, PCAMRS and Department of Agriculture- DA-BAR. Funding and technical assistance came from the Australian Centre for International Agricultural Research (ACIAR).

The RPPAP aimed to develop and install a decision-support system for research prioritisation. The project made use of the economic surplus model to quantify welfare gains/benefits from investment in research. A database on the following variables was developed.

I. **Economic variables:** Production, consumption, prices, elasticities, research expenditure, manpower/equipment needs, ceiling level of adoption, and rate of adoption,

II. **Technical information:** Research objective, time lags (innovative research, adaptive research), and externalities,

III. **Subjective data:** Probability of research success (across regions and commodities), and spillover effects.

To facilitate the institutionalisation of the model, the project provided training to the staff, including research team, methodology seminars as well as support for post-graduate study. A series of policy briefs based on project results were undertaken. Hands-on training on the application of model was also given following a national workshop to validate the existing priorities of the NAREA of the Department of Agriculture. To date and for some reasons, however, this attempt at institutionalising priority setting lost its steam.

5. Decentralisation of PME

In 1986, the full operationalisation of the regional consortium arrangement was attained. The regions (14 in all) were given the responsibility to plan, monitor and evaluate their R&D activities.

The process of prioritisation was similar to the PCARRD and the other agencies (i.e., BAR, ERDB). This led to identification, packaging of flagship programmes at the regional level, which the regional agencies funds and implements with seed fund and technical assistance from the PCARRD. In addition, however, several monitoring and evaluation schemes were also put in place. These mechanisms include: field evaluation; agency in-house review; regional symposium on R&D highlights; semi-annual and annual technical and financial reporting; monitoring of special projects; and seminars to discuss research results.

These mechanisms, while having their own specific objectives, were generally aimed at:

- determining progress and attainment of objectives;
- identifying the status of technologies for information generated or verified so far;
- assessing the appropriateness of the methodology;
- determining the efficiency of the use of resources (budget, scientist's time);
- identifying problems in implementation and solutions recommended; and
- identifying new research areas of possible spin-off projects.

Field evaluation: Field evaluation of on-going projects consists of visits to projects' sites at specific dates during project implementation. The schedule of field visits is coordinated by the PCARRD with the regional consortium and the research agencies involved. The PCARRD directors, national commodity team leaders and members, centre/station directors, donors and other may be involved in this activity.

Agency in-house review: The agency in-house review is an annual review of on-going and completed projects. It is *a* review at the research implementing level. All agencies in the NARRDN are currently involved in this annual activity. The preparation and conduct of the agency in-house review is done by the office of the Research Director or equivalent unit within the agency. The regional consortium secretariat coordinates and synchronises the schedule of all agency in-house reviews in a given region.

During the review, researchers present the progress and highlights of their projects in a forum attended by colleagues from the same agency. A panel of external experts, representing various disciplines and agencies, serves as evaluator.

Regional symposium on R&D highlights: Technologies identified during the agency review are presented by researchers for review and initial dissemination to users and other clients groups. The regional symposium has become an important venue to obtain users' perspective in the research and review processes. It also exposes researchers to clients' needs and demand.

The secretariat of the regional consortium plans and conducts the regional symposium. The PCARRD coordinates across consortium, synchronises the schedule nation-wide and provides the external evaluation panels.

Special workshops, seminars and conferences: Special workshops, seminars and scientific or policy conferences are periodically conducted to serve as venue for researchers to present their research findings for dissemination to policy makers, special client groups, politicians, scientists and others. This may take the form of regular seminars coordinated by a consortium, or at national level sponsored by the PCARRD.

Development of computer-assisted information system: Three information systems were developed by the PCARRD to support R&D programme planning, monitoring and evaluation: Research Management Information System (RMIS), Research Information Storage and Retrieval System (RETRES) and Agriculture and Regional Research Technology Information System (ARRTIS). The RMIS provides a complete and comprehensive inventory of all new, on-going and completed projects, while RETRES facilitates literature search and supports scientific literature services by providing the bibliographic database of completed researches, publications, monographs and related literature. On the other hand, the ARRTIS documents, monitors and compiles all technologies generated from research activities. These systems are currently being decentralised to the regions.

Focusing on grants-in-aid (GIA) funds: Generally, the GIA funds of the PCARRD and DOST account for 7-10 per cent of the total R&D budget in agriculture, forestry and natural resources. These funds are now earmarked for areas considered as high science or upstream research for two reasons: (a) to pole-vault from traditional resource-based science to information-based and agro-industrial science, and (b) to strengthen the role of the Department of Agriculture, DENR and other developing SCUs in the downstream science/research. In this policy, areas considered as high science are considered Priority I. Others such as those related to integrated soil, nutrient and water management are considered Priority II. In terms of commodity/product priorities, the grouping used in STAND is considered.

Manualisation of PME methods. The guidelines, criteria, report formats, etc. were documented to enhance the understanding and appreciation for the processes and to facilitate standardisation reporting of all R&D activities of all the actors/institutions involved at all levels.

Holding of regular consultation, fora and conferences: At the PCARRD level, PME activities/issues were taken up in the bi-monthly Governing Council meeting, monthly meeting of Technical Advisory Committee/Technology Transfer Advisory Committee and the commodity team meetings (twice a year). In addition, the PCARRD holds two meetings in a year with the regional consortia leaders.

6. Conclusions

From the Philippine experience, the following conclusions can be drawn relating to the institutionalisation of PME in agricultural research system:

1. There are three key factors which can affect institutionalisation: (a) linkage between national development goals and research goals/priorities; (b) institutional environment of research, and (c) the need to develop and put in place information system for decision-making. As regards the first item (a), the choice parameters must be defined in the context of research so that appropriate indicators can be assigned for those parameters and a system for data collection and reporting can be put in place at all levels. For item (b), several levels of prioritisation and even for monitoring and evaluation are necessary not only to create a credible database but also to develop capacities below the national level. The information system (c) is also necessary irrespective of the analytical methods used. This information need is more pronounced in formal methods like benefit-cost ratio and mathematical programming.
2. For all the three factors, the following inputs need to be provided: (a) regular staff dedicated for planning, monitoring and evaluation at each level, (b) information technology resources; (c) training programmes in information technology and formal methods of priority setting and resource allocation, (d) policy advocacy for the institutionalisation of PME by conducting seminars for policy makers, (e) conscious effort to demonstrate the link between priority setting, monitoring and evaluation to ensure the relevance of priorities to social welfare or benefits to the economy and clients.
3. With the advances in information technology, it may not be very difficult to advocate for more resources to improve the decision-support system for PME. While scoring model will still be used, the trend is to complement and rely more on robust methods of research prioritisation.

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6 Institutionalisation of Research Priority Setting, Monitoring and Evaluation- The IARI Experience*

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1. Introduction

The Indian Agricultural Research Institute (IARI) has been the backbone of India's agricultural research. The growth of India's agriculture during the past 100 years or so is closely linked with the researches done and technologies generated, human resources developed and extension concepts and guidelines formulated by the Institute. Established in 1905, IARI, comprising 20 Divisions, 6 Multi-disciplinary Centres, 9 Regional Research Centres, 2 Off-Season Nurseries and the attached 10 All India Coordinated Research Projects, constitutes one of the largest research institutes in the world. Having been granted by the University Grants Commission (UGC) the status of a "Deemed-to-be-University" in 1958, IARI is also the leading Post-Graduate School in agricultural sciences in the country.

The Institute has been adjusting its research priorities usually based on knowledge of its managers and scientists, the national policy declarations, and the new opportunities and challenges. In the early years, through its various national level scientific surveys related to soil and water resources, pests, diseases and agrobiodiversity, it had accumulated wealth of information which underpinned the national research and development planning as well as policy formulation. The institute laid the scientific foundation of crop improvement, soil fertility and water resources research and control of diseases and pests in the country and produced technologies of international significance.

During the 1960s, the government of India took bold decisions to modernise Indian agriculture on the pattern of the Land Grant College system of the USA, and IARI was the first to organise its programmes according to this system. The Institute provided new directions to country's research programmes. For instance, the potential of semi-dwarf, fertilizer responsive and non-lodging high yielding wheats was first tested and demonstrated in IARI fields. Recognising the potential of new plant types, and the need for increasing production and productivity, the Institute gave highest priority to the development of high yielding varieties (HYVs) of wheat, rice and other major crops. During this era, highest priority was given to the evolution, development and standardisation of packages of practices based on increased use of fertilizer, irrigation and agro-chemicals. Realising that the HYVs were fast displacing landraces, the Institute took lead in establishing a Division of Plant Introduction, now the National Bureau of Plant Genetic Resources, again breaking a new path. Necessitated by new national and international developments, the Institute strengthened its programmes in the areas of integrated pest management, water technology research, integrated plant nutrient management, nuclear research and lately biotechnological research.

The above shifts and adjustments, however, were not based on any structured priority-setting mechanism, neither there was any effort in the past to institutionalise this process. While generally the research technology outputs have been quite effective, there are at times cases of inefficiency and under exploitation of our resources. Indian agriculture is currently experiencing several unprecedented pressures and prospects. Being the premier Institute of the country for agricultural research, education and extension, at this critical juncture, the Institute is in process of evolving a priority setting and programme implementation arrangement so that it may effectively meet the new challenges and opportunities. This paper describes the existing mechanisms of priority setting, monitoring and evaluation (PME) and forwards suggestions for strengthening this mechanism.

2. Internal and External Environment of the Institute

During the past 35 years, the Green Revolution era, the research environment of IARI has changed considerably. Basic and strategic research had suffered at the cost of commodities research. The accent on mono-discipline research and thrust on developing new HYVs of the Green Revolution crops was pursued at the cost of system-based multidisciplinary research on natural and other production resources and orphan commodities and resource-poor farmers. These have caused regional imbalances and fragmentation of researches and resources. The dependence on technologies developed at the International Agricultural Research Centres (lARCs), especially for breeding materials and even fixed lines in several major crops, has increased. On the other hand, of late, the resources of the lARCs as also flow of their technologies, are getting truncated and there is increasing demand that the lARCs should work in a partnership mode with national agricultural research institutes.

In the post-Green Revolution period, food production has kept pace with population growth. However, despite substantial progress in food production, poverty remains widespread among the resource poor, wage dependent households. Nearly two-thirds of total income goes to purchase food. Agriculture, as provider of both food and jobs, thus is vital in overcoming poverty and can be sustained in the future only by producing more food, fuelwood, fodder and fibre from less land, less water and less energy.

In the context of continued increase in population, diminishing land and freshwater resources, expanding biotic and abiotic stresses, and a slow growth in gainful employment opportunities, the food security challenges of today and of tomorrow, are not only to maintain self-sufficiency in food production which is fundamental for the continued economic development, but also to expand the economic access to food to ensure food security at the household level.

In the long run, food availability is constrained because of deceleration in the growth rate in agricultural total factor productivity, fatigue in the rice-wheat system, ecological factors including soil erosion and pollution of water, genetic erosion, and accumulation of green house gases.

Our competitive ability in sharing the global market and access to new technologies, such as biotechnology, is rather poor. Further, in the context of gender and eco-regions, inequality has been growing and the unholy alliance of poverty, environmental degradation and food insecurity has intensified in recent years. In order to explore the opportunities of economic liberalisation and also to ensure food security, a balance must be struck between food self-sufficiency and food self-reliance to exploit the country's comparative advantage for agricultural imports and exports.

Another most important feature is the high population pressure and shift in poverty-mix and food basket because of high migration to urban areas, low availability of agricultural land and little scope for horizontal expansion, widespread irrigation-related problems, increasing incidence of pests and diseases, low average yields of important crops and commodities, paucity of quality and well-trained human resources, especially in frontier and newly emerging research areas, and poor linkage among the institutions of the country.

Thus, the right research priorities need to be identified and development strategies need to be reoriented to improve the quality of human life. This calls for sustainable agriculture and rural development for ensuring adequate food and nutrition by physical and economic access to balanced diet and safe drinking water at the level of the individual households.

3. Mechanism of Priority Setting

During the Green Revolution era, as mentioned earlier, the priorities were set through a supply-driven process. However, keeping in mind the changing needs, opportunities and challenges, as described in the earlier section, the present approach must be demand-driven. This calls for a more effective participatory approach in the priority-setting process. Under this paradigm shift, new processes of priority setting have been instituted. These include the newly constituted Research Advisory Committee (RAC), whose constitution and functions are given in the Annexure. Under the framework of the Institute mandate and mission and under the overall guidance of the Board of Management, RAC identifies priority areas of research in different disciplines through an effective participation of scientists and research managers.

Identification of the research priorities at the IARI uses a two-pronged approach. One approach is to identify the research priorities through the process of scientific seminars/workshops/conferences, where the current trends and developments at the national and international level are taken as basis for identifying national issues. The other is the participatory approach.

The participatory approach involves research-extension-farmer-people linkages. The Institute's National Demonstration Project, Operational Research Projects, Seed Village Scheme, Small and Marginal Farmers Development Programme, and Institute Village Linkage Programme (IVLP) provide a mechanism for an interactive participatory approach to research priorities identification. Direct interaction with the farmers allows regular feedback from the farmers to the scientists. This exercise helps to set research priorities of the IARI. This approach also permits the assessment and refinement of the problem and location specific technologies development. For instance, specific feedback provided for improving research agenda of the Institute on wheat, mustard, pigeonpea and vegetables are illustrated below.

Wheat

1. A salt-tolerant variety like Raj. 3765 is needed which could be grown in salt-affected areas. The variety should produce about 45 q/ha.
2. HD 2329 is still the most popular and promising variety in wheat growing areas (irrigated, timely sown). It is highly responsive to fertilizers and is non-lodging type.
3. HD 2285 is now susceptible to loosesmut.
4. Phalaris minor is a growing menace and cannot be controlled fully by the application of Isoproturon. More research is needed in weed control.

Mustard

1. PR-45 variety in rainfed conditions and Bio-902 in limited irrigated conditions are successful varieties.
2. Farmers have noticed shattering in Bio-902 and RH-30. These varieties need to be further improved to make them non-shattering type.
3. Short statured (dwarf and compact) mustard varieties are preferred so that spraying operations could be easily performed.
4. Farmers need varieties with duration of about 100 days.

Pigeon pea

1. Use of recommended procedures of control of pod-borer does not bear any results. More perfection is needed in integrated pest management (IPM). Claim on biological control be verified.
2. Extra-early maturing varieties have to be made available to the farmers at the earliest.
3. Short statured (dwarf) varieties are needed to undertake plant protection measures.

Vegetables

1. HYB-1 tomato is superior to HYB-2 in round shape, size, colour, etc. The skin of HYB-1 does not crack. However, it is less sour than other varieties (e.g., Pusa Ruby).
2. Red varieties of onion are preferred over white varieties.
3. Untimely sowing of vegetables specially cauliflower, results into failure of crops.

4. Farmers use excess of pesticides in vegetable crops. IPM technologies in major vegetables need to be developed and perfected.

General

1. Participatory approach seeks close involvement of IARI scientists.
2. Trials on the use of aqua-ferti-seed drill need to be conducted on a larger scale to show its utility.
3. Zero-tillage in crops (wheat) has been successful in irrigated areas. It needs to be popularised.
4. Khurpa-cum-sickle was effective in reducing drudgery in women. More such equipment need to be developed to help farm women.

The methodology followed in which the farmers, farm women, rural youths and IARI scientists through Participatory Rural Appraisal (PRA) techniques jointly identified problems and analysed them to locate specific causes of the same. This analysis leads the participating farmers and scientists to identify specific interventions. This scientist-farmer participatory approach helps in the identification of the problems and their causes as well as the bio-physical research issues required to tackle the problems. This approach is simple, transparent and may allow timely results.

Based on the priorities set, scientists of the Institute develop the research projects and activities. These research projects are reviewed by the Budget and Research Committee (BRC), constituted at the divisional level, whose constitution and functions are given in the Annexure, and sent to the research project information cell which is known as Project Planning and Implementation (PPI) cell. PPI sends the project proposals to the referees for evaluation. The scientists modify/revise the proposal based on the referee's comments. Again project proposal is presented to the Staff Research Council (SRC) constituted at the Institute level, whose constitution and functions are also given in the Annexure, for its screening and final approval. The progress is reviewed by the Head of the Division, Joint Director (Research), Director and SRC periodically. The review process at the SRC level and performance of technologies at the field level provide the feedback to the various schools of the Institute to revise their old research programme or to take-up the new research programme and generate the new information and feed to the research PME cell of the Institute.

4. Monitoring and Evaluation

During the past 30 years, the country's research and education system has witnessed a sea change. A vast network of the ICAR and other central research institutes, state agricultural universities, national agricultural research projects and the private sector has come up in a big way, addressing themselves to resource, commodity and regionally oriented research problems. The SRC critically examines activities and outputs of individual projects. Based on achievements and shortcomings, the SRC makes mid-course adjustments in on-going projects. It also suggests termination of poor performing projects. It advises on fostering linkages and establishing new linkages. The Divisional BRC makes necessary adjustments in resource allocation according to the recommendations of the SRC.

Pre-Agricultural Research Service (ARS) which was introduced on first October 1975 in ICAR, each division of agricultural discipline in the Institute was having several sections (programmes). Each section was headed by the senior most scientist in that programme, who ensured collaborative research and coordination. The leader was undertaking evaluation of his programme. The head of the division was reviewing the evaluation/performance report of each sectoral leader and his/her team. The Heads/Director decided research priorities based on the report of the head, the national requirements and availability of resources.

During the post-ARS, the individual scientists were made responsible for formulating and carrying-out their individual projects/sub-projects. The projects were evaluated through the system of research project file (RPF): RPF I (project proposal), RPF II (annual progress and future technical programme), and RPF III (final report of the project /sub-project). The RPF formats were well structured and having all the relevant information with the provision of critical monitoring and evaluation system of the research project. The evaluation reports of the Head/Director on the project of the scientists were considered at five-yearly assessment of individual scientists by the Agricultural Scientist Recruitment Board (ASRB) for career advancement and promotion. The ARS policy although opened the avenue of fast carrier advancement but lead to the fragmentation of sectional/programme based team research.

After 1986, following adoption of the UGC pay-package by the scientists of the ICAR, the ARS assessment system were diluted and the value of RPFs also declined. This had posed a threat to the seriousness of the monitoring and evaluation of the project/programme and led to frustration among the scientists because of lack of opportunity of their career advancement.

Notwithstanding several constraints, a good number of significant research contributions have been made by the Institute. Allocation of resources to individual programmes has always not matched with priority needs and often there is a mismatch among equipment, operational funds and trained manpower. Over the years, operational/contingency grant per scientist, in real terms, has declined while costs of consumable and labour has escalated several-fold. The vast and often old and ageing buildings and other infrastructures have not been kept in view while allocating maintenance and development grants to the Institute. In actual terms, there is serious erosion in the financial outlay, especially in the operational funds. Because of this constraint, mechanisms of monitoring and evaluation were generally ineffective. The Planning Cell staff is not trained in relevant economic analysis. Moreover access to experimental data for economic analysis is a problem. Little effort is made to assemble and present quantitative information in a way that facilitates the research manager. Information on economic benefits of research and their spillover effects is lacking.

5. Suggestions for Strengthening the Mechanism

Although a beginning in the right direction has been made for creating a mechanism for PME, we still have a long way to go in making the system effective, responsive and accountable. It is proposed to rename the existing PPI Cell as PME Cell, comprising experts from each school of the IARI, namely, School of Basic Sciences, School of Crop Improvement, School of Resource Conservation and Management, School of Crop Protection, and School of Social Sciences. The Cell should be headed by an economist fully conversant with PME and impact analysis approaches. This Cell must have access to national and international data bases. It means that the Institute should have a strong information system, which is nearing completion. The Cell should also have close linkages with all the Divisions, Project Directorates, Coordinated Programmes and Regional Stations within the IARI and with similar units at the ICAR headquarters, ICAR institutes and SAUs.

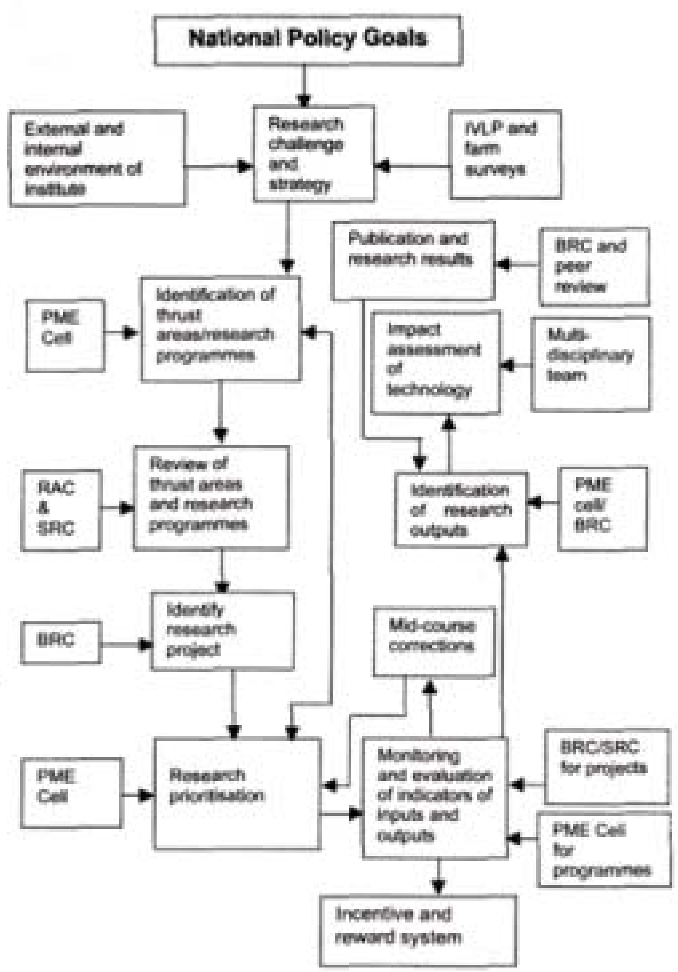
The Cell must have particularly a close linkage with the Division of Agricultural Economics which must undertake policy research addressing the issues of equity, sustainability, productivity, food security and self-reliance. For this purpose, the Cell and the Division of Agricultural Economics should have access to experimental data generated by scientists and those working in the area of technology assessment. Periodical training should be given to selected staff from each Division to render them fully conversant and equipped to undertake necessary monitoring and evaluation exercises in their respective disciplines.

In particular, for monitoring and evaluation the following suggestions are made:

- Workshops to sensitise top-level research managers on PME.
- In-depth training for selected scientists and economists in methods for research priority setting and evaluation.
- Institutions must adopt the inter-disciplinary/matrix approach for programme formulation.

- The entire programme must be reviewed regularly by the peers, divisional BRC, SRC and RAC in a proactive manner.
- Follow the guiding principles as shown in Figure 6.1 to improve mechanism for PME.
- Adopt project-based funding.
- Activity and output milestones must be closely identified.
- Input/role of individual scientists must be specified, providing for clear cut responsibility and accountability. Personnel performance evaluation is must.
- Mechanisms of internalisation of the PME recommendations, comprising allocation of funds, incentives and check must be evolved and institutionalised. PME must be fully integrated with mechanisms to drop unproductive/unsatisfactory projects.
- Divisions must organise a seminar week once in six months in which each project leader should present the work carried out by each of the scientist in his group indicating the contributions made by them. The project leader must prepare a progress report along with the summary, graph and tables before the seminar and submit to the Head of the Division for circulation.
- The Heads of the Divisions must prepare and print a consolidated report of their Divisions for circulation and present the highlights during the Annual Convocation week of the Institute.
- Three types of reports should be prepared by project leaders at the completion of each project (a) full report, (b) executive summary, and (c) research highlights. These should be submitted for review to the publication committee of the Institute. The publication committee should get them reviewed from two experts one from outside and another within the Institute.

Figure 6.1: PME mechanism at the institute level



Annexure

Constitution and terms of reference of various managerial and advisory committees effectively involved in research PME process at the IARI.

Research Advisory Committee

Constitution

Chairman: An eminent scientist from outside the ICAR system nominated by the Director-General, ICAR.

Members

- Four to five external experts (including retired scientists of ICAR) representing the major areas of research and development programmes of the Institute nominated by the Director-General, ICAR
- Director of the Institute
- Deputy Director-General (Crops)
- Two persons representing agricultural/rural interest

Member-secretary: One senior level scientist of the Institute nominated by the Director.

Terms of Reference

i. To suggest research programmes based on national and global context of research in the thrust areas,
ii. To review the research achievements of the Institute and to see that these are consistent with the mandate of the Institute.

Staff Research Council

Constitution

Chairman: Director of the Institute

Members

- Joint Director (Research)/In-charge (Research Coordination and Management Unit)
- Heads of Divisions/ Sections
- All Principal Investigators of the Projects
- Deputy Director-General (Crops)
- Two to three subjects matter specialists nominated by the Director-General of the ICAR from outside, representing major disciplines of the Institutes/from outside the Institute

Member-Secretary: Scientist in-charge of the Research Coordination and Management Unit at the Institute.

Terms of Reference

i. Consideration and evaluation of research projects (RPF-1 research proposal). The Principal investigator will make presentation of research project in the SRC. The SRC will reject/recommend the project along with its duration.

ii. Consideration and evaluation of the on-going projects (RPF II annual research progress report) after these have been assessed by an expert. The SRC will make specific recommendations about the achievements and short-comings of the projects.
iii. Advise on the fostering of linkages between the groups/Divisions/Institutes in respect of multi-disciplinary projects/multi-locational projects.
iv. Monitor the follow-up action on the recommendations of Quinquennial Review Team (QRT) with respect to technical programmes of the Institute.

Divisional Budget and Research Committee

Constitution

Chairman: Head of the Division

Members

- Two Principal Scientists from the Division
- Two Senior Scientists from the Division

Member-Secretary: Scientists from the Division

Terms of Reference

i. Prepare the budget requirement for various activities of the Division and submit to the Institute.
ii. Allocation of resources to various activities of the Division,
iii. Consider the items of expenditure costing more than Rs 10,000.
iv. Monitor the expenditure of budget allocated to the Division by the Institute and other financial body,
v. Identify the thrust areas of research in the discipline and propose the research programmes and sub-programmes to the RAC and SRC.
vi. Consider and evaluate research projects proposals (RPF-I) of scientists. Advise on the fostering of linkages between the Disciplines/Divisions of the Institute and outside.
vii. Monitor and evaluate the on-going projects (RPF-II annual research progress reports and RPF-III final reports),
viii. Monitor the follow up action on the recommendations of the QRT with respect to programmes of the Division.

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7 Institutionalisation of Research Prioritsation, Monitoring and Evaluation

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1. Introduction

Research priority setting, monitoring and evaluation (PME) have recently been introduced as research management tools to efficiently allocate scarce research resources to alternative choices. With squeezing agricultural research resources, research managers explore procedures to allocate available resources to meet the unprecedented challenges of increasing demand for additional food, and ever rising degradation of natural resources. An efficient and well prioritised research resource allocation is reckoned to make maximum contribution in improving the welfare gains of the society. To better allocate limited research resources among alternative researchable areas, it is now recognised the need to institutionalise the process of PME.

In the recent past, several national and international research organisations have institutionalised the research priority setting for resource allocation. Among others, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is one research organisation which has institutionalised the research priority setting and evaluation to develop its Medium Term Plan (MTP). Several approaches were suggested and used by different research organisations and authors for research priority setting (Davis et al., 1987; Alston et al., 1995). These approaches are: (i) congruence rule, (ii) economic surplus approach, (iii) mathematical programming approach, and (iv) scoring method. Each method was argued for some advantages and limitations. The ICRISAT adopted a multi-objective scoring approach, which provided strong basis for decision support system to allocate available research resources in the most transparent way.

The present paper briefly documents the framework implemented by the ICRISAT in this important area of research management and policy. It also suggests a mechanism to institutionalise PME in the Indian Council of Agricultural Research (ICAR) on a sustained basis. More specifically,

the paper deals with: (i) ICRISAT model on research priority framework, (ii) ICRISAT model on research evaluation and impact assessment, and (iii) lessons for the ICAR on adaptability of the ICRISAT model to institutionalise PME.

2. ICRISAT Research Priority Model

The ICRISAT's research focus is to enhance productivity and profitability of its five mandate crops (namely, chickpea, groundnut, pearl millet, pigeonpea and sorghum); improve the sustainability of soil and water resources; and uplift the living standard of poor depending on rainfed agriculture in the semi-arid tropics. Before 1994, the ICRISAT mandate was achieved through three programmes: Cereals Improvement Programme (including sorghum and pearl millet), Legumes Improvement Programme (including chickpea, groundnut and pigeonpea), and Resource Management Programme (including soils, agronomy and economics). Research resource allocation to these programmes was mostly informal and largely based on the scientific judgement of research managers. With declining research funds, an objective and transparent method of research priority setting and research resource allocation was strongly felt and initiated in 1992 to develop the MTP 1994-98. The main focus of the exercise was to eliminate those research areas which were of less relevance to the ICRISAT in a limited budget scenario. The method was regarded analytically rigorous with clear criteria for decision-making process (ICRISAT, 1992).

A multi-disciplinary Working Group was constituted consisting of scientists from various research programmes and groups. At the first instant, the Working Group defined the research domains. A research domain was defined as a homogenous eco-region, where the expected research outputs were relevant. These were delineated for each commodity on the basis of (a) production system characteristics (e.g., rainfall, soil type, cropping pattern); (b) major biotic and abiotic constraints in the production systems; and (c) location. Production constraints across locations in the semi-arid tropics were listed. Yield loss due to each constraint, and expected gains resulting from successful research were estimated. All the scientists were involved to assess yield losses and expected gains due to the research success. It also identified the strategy which was expected to alleviate specific constraint most effectively. To be more specific, the decision was made whether research should focus on genetic improvement or resource management or both to alleviate a given constraint in a specific research domain. In all, 110 research constraints were identified for research priority setting in the semi-arid tropics. Later, these constraints were termed as the research themes.

A multi-objective scoring model was developed for research priority setting in the semi-arid tropics. The multiple objectives were: (a) efficiency, which was measured as the net present value, the net benefit-cost ratio and the internal rate of return; (b) poverty, which was measured as number of poor in the research domain where the research theme was focused; (c) gender issues were included as number of illiterate female in the research domain; (d) internationality of the theme was computed as the Simpson Index of diversity; and (e) environment and sustainability contributions were given scores ranging from 1-5: 1, no contribution towards environment and sustainability, and 5, highest contribution. Poverty and gender issues were regarded proxy for equity considerations.

To measure efficiency of research investment, benefit-cost analysis was carried-out for each research theme in ex ante framework. A data-set (Details in chapter 3 of this volume) consisting of various quantitative variables relating to research, technology adoption, yield gains, and production and prices of commodities, was generated for each theme in all the research domains to estimate the net present value, net benefit-cost ratio and internal rate of return.

To combine the estimated values of multiple objectives, composite indices were computed for all research themes following the additive model by assigning equal weight to each criteria. All 110 researchable themes were sorted in descending order which provided a list of themes with highest composite index at the top and the lowest at the end. This indicated that the research theme attaining highest composite index should receive highest research priority, and vice versa for the constraint with lowest composite index. Research cost for each theme was also estimated, and cumulative research cost was computed according to the rank of the composite index. The methodology used in setting research priorities provided clear criteria for establishing choices among competing research activities, which was considered analytically rigorous, drew on scientists' empirical and intuitive knowledge base, and was transparent and interactive (Kelly et at., 1995).

Finally, top 92 research themes were selected to develop research projects as the funds were not available beyond that rating (Appendix I). All selected themes were finally used to develop 22 global research projects by combining themes of similar nature relevant to different crops, resource management, and socio-economic aspects.

Recently, the ICRISAT's new MTP 1998-2000 was developed following similar approach and criteria as used in 1994-98 plan but with slight change and updating of available information. The criteria consisted of: efficiency (calculated as in the last MTP), equity (including the new poverty modifier), internationally (including "alternative sources of supply" element, along with cross border consideration), and sustainability (including an explicit recognition of the importance of diversification of agricultural systems). The new criteria used in 1998-2000

MTP were new science opportunity, research relevance to the NARS priorities, and future trends in supply and demand that could change basic assumptions (ICRISAT, 1997).

3. Research Evaluation and Impact Assessment

It is always useful to regularly monitor and evaluate the research impact. There are three important benefits of monitoring and assessing the research impacts: (i) provide a basis for justifying research support, thereby leading to adequate investments in agricultural research; (ii) provide the basis for making a more efficient use of research resources, and (iii) provide the basis for making agricultural research a more effective contributor to agricultural development (Schuh and Tollini, 1979). To strengthen the research priority setting in a dynamic framework, the ICRISAT research management took a policy decision in 1994 to continuously monitor and evaluate research impacts. To adhere to this policy decision, a global research project on "Research Evaluation and Impact Assessment" (REIA) was initiated to document the benefits from research, use the information for research priority setting, and justify future funding. The project was designed to integrate ex post impact assessment with ex ante priority setting in dynamic framework adapted to suit the requirement of the ICRISAT. The main objectives of the project were: (a) develop methodologies, database, and ICRISAT/NARS capacity to support research evaluation, (b) quantify research benefits from ICRISAT/NARS research finished products, (c) estimate value of the ICRISAT germplasm/parental lines and other intermediate products, (d) establish a decision support system for research priority setting, and (e) institutionalise research evaluation process.

The first step to evaluate impact of ICRISAT/NARS technologies was development of an inventory of all research outputs. This was accomplished through an interactive approach with the agro-biological and social scientists. The objective was to identify technology components as a result of research investment, understand the research process of each technology, background of the technology development, and possible target domains of the technology. An inventory of research outputs was developed in three areas: (a) genetic enhancement of all the ICRISAT mandate commodities, (b) research information related to resource management technologies, and plant protection measures, and (c) socio-economic and policy research (Bantilan and Joshi, 1994). Under each area of research, technologies or research information were divided into two categories: (a) technologies successfully adopted by the farmers, and (b) technologies faced constraints in adoption. Technologies under the former category were selected for impact assessment, and the technologies listed under the second category were considered for constraint analysis. It was recognised that analysis on impact assessment and constraint analysis are important to effectively integrate these analysis with the research priority setting.

A systematic framework was designed to evaluate technologies for impact assessment (Bantilan, 1996). At the outset, number of impact indicators were identified for assessing impact at various stages. A list of these impact indicators is given below:

(a) Farm level impact indicators: Farm income, input saving, household food security, household poverty, risk and uncertainty, crop intensification, nutrition and health issues, gender related issues, and sustainability issues.

(b) Regional level impact indicators: Employment issues, food security issues, poverty, diversification and regional development, prices, and sustainability issues.

(c) Global level impact indicators: Efficiency, trade, commodity prices, spillover effects, and sustainability and environmental issues.

A number of methodologies are available to measure above mentioned impact indicators. Economic surplus approach, the most popular method for ex post impact assessment, was used for majority of the studies. This approach assumes the welfare effects of agricultural research in a conventional, comparative static, partial equilibrium model of supply and demand in a commodity market. Impact assessment of each technology was carried-out by a multidisciplinary team of scientists at the ICRISAT and NARSs. A database was jointly developed by the multidisciplinary team of scientists at the ICRISAT and NARS for quantifying impact of each technology. It included following set of information:

- Estimates of research cost including salary, operations, overheads, etc.
- Area and production of particular commodity at national, district and block level from official and published sources.
- Yield loss estimates due to the constraints.
- Research lag.
- Adoption tracking through:
    - Breeder seed distribution,
    - certified or truthfully labelled seed sale by seed companies, and
    - farmer-to-farmer seed distribution.
- Extent of adoption through informal and formal survey methods.
- Estimates on adoption ceiling levels.
- Estimates on on-farm gains due to adoption of improved technologies.
- Farm harvest prices of commodity under study.
- Supply and demand elasticities of commodity under study.

Research and adoption tag, ceiling level of adoption, and internal rate of returns of few technologies were estimated, and are given in Appendix II. It may be noted that efficiency criteria was used at the initial stage of impact assessment to justify the research investment in alleviating various constraints in the semi-arid tropics. Evaluation of other impacts like poverty, diversification, nutrition, spillover effects, is under progress at various stages for different technologies.

NARSs were effectively involved in quantifying the impact of various ICRISAT/NARS technologies. Training workshops and study programmes were organised to institutionalise the impact assessment of all collaborating programmes with NARS.

4. Integration of Research Prioritisation and Impact Assessment

The REIA project consists of a separate sub-project on research priority setting. The need was felt to integrate research evaluation with the research priority setting. A mechanism was developed to link the REIA project with all the global projects to institutionalise the research prioritisation and impact assessment.

Impact assessment studies provided more confidence among scientists in projecting research lags, research cost, extent of adoption, adoption ceiling and research gains. The adoption assessment and impact evaluation studies provided useful feedback for research priority setting while developing the 1998-2000 MTP of the ICRISAT. More reliable estimates derived from ex post studies were used for ex ante analysis for research priority setting. The ex post impact assessment studies also validated, in some cases, the research prioritisation and evaluation.

5. Adaptability of ICRISAT Model in ICAR

The apex organisation like the ICAR may encounter the problem of resource allocation to different research institutes/centres which are engaged in alleviating various production and socio-economic constraints. Once research resources are allocated, the research institutes/centres face the problem of distributing the available resources into different projects and research activities. Recently, few studies were initiated to prioritise agricultural research in India (Jha et al., 1995, and Ramasamy et al., 1997), making a good beginning in this area.

The ICRISAT model of research priority setting and impact assessment may be well suited at all the ICAR research institutes/centres, the State Agricultural Universities (SAUs), and their regional research stations to allocate resources up to the project and activity level. The problem may be encountered by the ICAR to allocate research resources to different research institutes. In the beginning, congruence rule may be applied at the ICAR level to allocate research resources to different research institutes/centres. Later, more rigorous analysis with multiple objectives may be used for each commodity, resource management, and socio-economic based research institutes/centres.

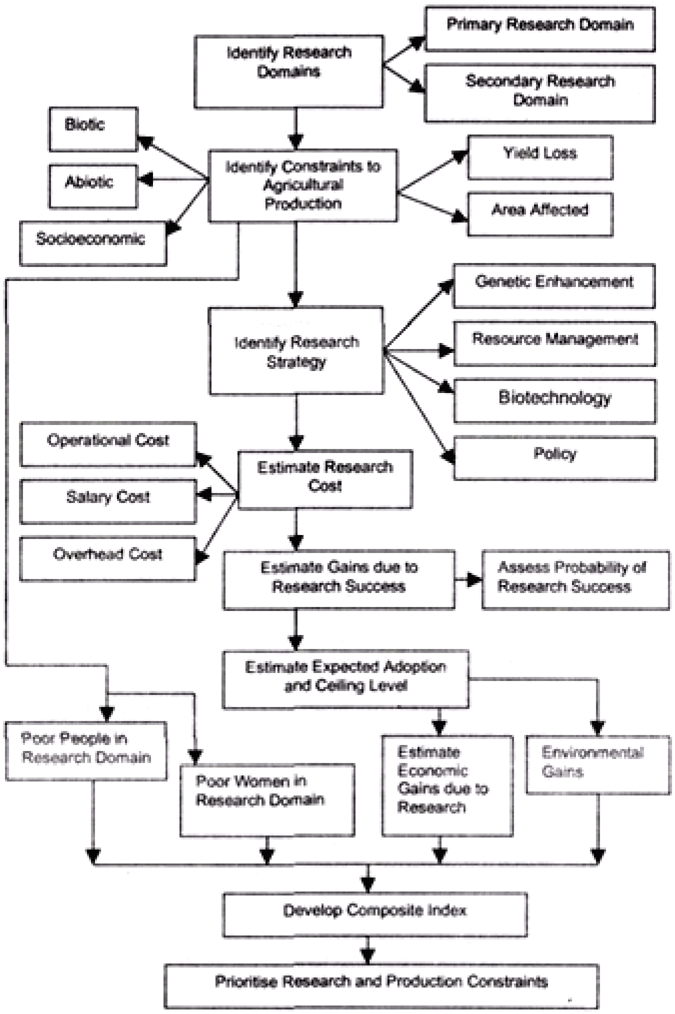
A simple procedure may be followed to prioritise research at each research institute/centre level. A framework for research prioritisation is given in Figure 7.1 which is summarised in following steps: Initially, above steps may be followed to prioritise research in each research institute/centre. Later, all themes from all research institutes/centres may be amalgamated and prioritised to allocate available research resources at ICAR level according to crops, agro-ecological regions, disciplines, research institutes/centres, and so on.

1. Clearly define the research domains. These may be delineated according to rainfall, soil, cropping pattern, socio-economic considerations, etc.
2. Identify production and socio-economic constraints in research domains with specific emphasis to the mandate of the research institute/centre. The production constraints may be abiotic, biotic and socio-economic. At this stage, it will be highly desirable to involve extension staff from the Training-and-Visit system of the department of agriculture and non-government organisations (NGOs).
3. Estimate yield loss due to each constraint, and delineate area affected due to the specific constraint.
4. Identify research strategy to alleviate production and socio-economic constraints. Research strategy may be one or a combination of genetic enhancement, resource management, biotechnology and policy research.
5. Estimate cost of each research strategy, and its probability of success. More discussions and interactions among scientists will yield better estimates on research cost and its probability of success. A low cost with high probability of research success will be the most preferred research strategy.
6. Measure gains due to research success in ex ante framework:

- Estimate expected adoption rate and adoption ceiling of the research output (a variety, or a research information on crop and resource management, or a policy).
- Estimate unit cost of production with and without research output. Compute reduction in unit cost of production due to the expected success of research output.
- Calculate total savings in production by multiplying the unit cost reduction with the base level of production of specific crop.
- Adjust total savings in production with probability of research success, adoption rate and adoption ceiling of research output, and develop a stream of benefits over a period of about 15 years.
- Compute net present worth, benefit-cost ratio and internal rate of return. Use stream of research costs and benefits for computing these efficiency indicators for each production constraints.
- Assign score to describe the contribution of each research success in improving environment and sustainability. Scores may range between 1-5: 1, no contribution; and 5, maximum contribution.

7. Use other indicators, like poverty and gender for research priority setting. Use number of poor people living below poverty line in the research domain to represent research focus to help poor women in the target area.
8. Develop a composite index for each production constraint by assigning equal weight to each indicator, namely, efficiency indicator (represented by net present worth), poverty, gender and sustainability. More number of indicators may be selected depending upon the national priority.
9. Rank the composite indices in descending order to prioritise production constraints.

Figure 7.1: A framework for research priority setting



6. Institutionalisation of Research Prioritisation in ICAR

For a sustained and continuous cycle of research priority setting and impact assessment, the concept of the All India Co-ordinated Research Project (AICRP) will provide an avenue for effective feedback and timely redirection of research. Implementation of a continuous and sustained effort involving database update, adoption/impact monitoring, and methodology adoption will promote a smooth implementation and achievement of a relevant, consistent, and objective set of defined priorities. These tasks can very well be taken-up by establishing an AICRP on 'Research Priority Setting and Impact Assessment'.

The AICRP should be responsible to collaborate and develop linkages with all the ICAR research institutes/centres and the SAUs. It will provide relevant updated database on important parameters, adapt uniform methodological framework across research institutes/centres and SAUs to compare results for better research resource allocation and targeting research agenda. Its role may also include to develop agricultural research policy in changing scenario. It should also organise training programmes to develop skills and capabilities of research scientists associated in research priority setting and impact assessment. To undertake the research priority setting uniformly by each research institute/centre, the project must have trained staff. Therefore, capacity building of the staff through training workshops should be viewed as prerequisite for its institutionalisation in the ICAR.

The AICRP may have its headquarters at the National Centre for Agricultural Economics and Policy Research. However, the project will be independent from various research institutes/centres and SAUs to avoid any kind of bias and influence, it may involve the stakeholders and its clients. It should develop a network by involving Agricultural Economics Division or Unit in each research institute/centre and SAD. The project may be horizontally linked with the Assistant Director-General (Economics, Statistics and Marketing), the Assistant Director-General (Project Planning and Monitoring), and the Director (Finance) to obtain relevant information from the ICAR headquarters.

7. Summing Up

The institutionalisation process on research priority setting and impact assessment should promote efficient research resource allocation, and provide a forum for decision support system in a dynamic framework. The ICRISAT model on research priority setting and impact assessment very well suits the needs of the ICAR, as this model is transparent and analytically rigorous for research priority setting and impact assessment. Also, the model encourages participation of scientists in multidisciplinary framework. An AICRP on research priority setting and impact assessment on ICRISAT model will be the most desirable policy decision to institutionalise research priority setting and evaluation in the ICAR institutes/centres and SAUs.

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Appendix I. ICRISAT's protfolio of ranked research themes

Rank	Programme	Constraint/ theme	Efficiency Net B/C ratio	Res. cost first year ($m)	Equity		Inter nationality	Sustaina Bility	Composite index ($m)	Cumul ative cost
					Poverty million poor	Gender million fern ill				
1	GRU	Germplasm evaluation	101.9	0.19	397.0	378.0	1.00	4	5.21	0.19
2	GRU	Germplasm collection	40.7	0.14	397.0	378.0	.100	5	4.24	0.33
3	LGM	Drought-CP	113.7	0.48	60.0	119.5	0.55	3	3.64	0.81
4	GRU	Germplasm maintenance	35.5	0.10	397.0	378.0	1.00	3	3.63	0.91
5	LGM	Ascochyta bligh-CP	134.7	0.14	31.1	94.4	057	1	3.48	1.05
6	LGM	Rust-GN	47.9	0.33	337.0	310.0	070	3	3.35	1.38
7	LGM	Aflatoxin-GN	23.1	0.05	248.2	298.6	082	5	3.28	1.43
8	LGM	Late leaf spot-GN	12.4	0.43	329.0	302.0	084	4	3.00	1.86
9	LGM	Alatoxin (MGT) GN	6.4	0.56	360.0	308.0	060	5	2.96	2.42
10	LGM	Insect damage-CP	78.5	0.25	88.2	107.9	026	4	2.94	2.67
11	LGM	Wilt-CP	114.2	0.14	88.2	107.9	026	1	2.90	2.81
12	RMP	Adopt Asses/ imp/.evl.	-	0.62	75.9	114.1	000	3	-	3.43
13	RMP	Res. Resource alloc'n	-	0.21	397.0	378.0	1 00	4	-	3.64
14	RMP	Soil nutrients	35.9	0.54	167.9	162.2	049	5	2.81	4.18
15	LGM	Early leaf spot-GN	4.4	0.46	345.0	313.0	070	4	2.75	4.63
16	LGM	Genetic poten'l yield-PP	63.5	0.13	125.2	168.2	023	3	2.53	4.76
17	LGM	Yield potential GN	12.3	0.44	234.2	363.4	071	3	2.53	5.20
18	CRL	Striga-SG	41.4	0.28	31.5	43.8	080	4	2.51	5.48

19	LGM	Drought-GN	5.2	0.50	331.8	326.0	062	3	2.43	5.98
20	LGM	Root rots-CP	70.3	0.14	88.2	107.9	033	2	2.34	6.12
21	LGM	Bud necrosis virus-GN	1.2	0.13	298.9	328.1	066	3	2.33	6.25
22	CRL	Grain & stover yield.- SG	16.6	0.68	180.8	169.2	085	3	2.33	6.93
23	RMP	Soil fertility	21.1	0.58	16.8	37.9	076	5	2.28	7.51
24	LGM	St mosaic/Fu Wilt-PP	40.4	0.21	125.2	168.2	012	4	2.21	7.72
25	RMP	Soil structure	5.9	0.74	167.9	162.2	046	5	2.18	8.46
26	LGM	Leaf miner-GN	6.0	0.19	195.7	268.6	046	4	2.17	8.65
27	LGM	Biolog N fixation-CP	16.6	0.10	88.2	133.7	043	5	2.16	8.75
28	LGM	Leaf miner (MGT)-GN	4.5	0.23	195.7	268.6	046	4	2.14	8.98
29	RMP	Water deficit	19.1	0.95	154.4	151.4	034	4	2.03	9.93
30	LGM	Spondoptera-GN	0.9	0.14	174.7	247.6	040	4	1.93	I0.07
31	LGM	Peanut clump virus GN	4.9	0.23	114.3	124.0	084	3	1.87	10.30
32	LGM	Rosette virus-GN	8.6	0.53	71.9	71.4	089	3	1.82	10.83
33	LGM	Hilicoverpa (MGT)-PP	23.8	0.17	98.2	136.4	017	4	1.82	11.00
34	CRL	Stem borer-SG	1.6	0.76	232.7	191.2	075	2	1.82	11.76
35	CRL	Grain mold-SG	21.5	0.45	51.2	57.2	068	3	1.81	12.21
36	LGM	Millipedes-GN	8.0	0.04	27.3	37.2	077	4	1.80	12.25
37	RMP	Water deficit-PM. SG. GN	3.9	0.83	24.1	42.6	076	4	1.71	13.08
38	RMP	Tech Adopt/ Imp Eval.	-	0.29	24.1	42.6	083	2		13.37
39	RMP	Agro-forsestry	3.5	0.60	24.1	42.6	076	4	1.70	13.97
40	RMP	Char'n of prod'n emit	-	0.72	24.1	426	0.76	3	-	14.69
41	LGM	Nematodes-GN, PP, CP	5.9	0.41	179.7	263.9	6.27	3	1.69	15.10
42	LGM	Termites-GN	24	0.11	273	37.2	077	4	1.68	15.21

43	LGM	Sub-optimal yield-CP	0.5	0.25	882	133.7	0.52	4	1.68	15.46
44	CRL	Low temperature-SG	9.6	0.19	32.7	11.8	060	4	1.63	15.65
45	LGM	While grubs-GN	1.6	0.11	27.3	37.2	0.72	4	1.62	15.76
46	CRL	Head bug-SG	7.1	0.27	43.2	74.8	076	3	1.61	16.03
47	LGM	Drought-PP	77	0.41	98.2	136.4	0.28	4	1.61	16.44
48	CRL	Anthracnose-SG	46	0.43	126.7	110.8	0.82	2	1.60	16.87
49	CRL	Midge-SG	4.1	0.52	566	47.1	0.82	3	1.59	17.39
50	RMP	Chaf'zation of environ.		0.25	75.9	114.1	0,00	3		17.64
51	RMP	Microecon studies	-	-	-	-	-	-	-	18.05
52	RMP	Natural resources		0.60	75.9	114.1	0,00	5	-	18.65
53	RMP	Supply & demand		021	75.9	114.1	0.00	4	-	18.86
54	RMP	Farmers' preferences		0.14	759	114.1	0.00	3	-	19.00
55	RMP	Beneficial organisms	11.3	0.41	624	104.9	0.27	4	1.55	19.41
56	RMP	Plant nutr'n-SG/ PM/FM	13.0	0.08	32.1	12.4	0.70	3	1.54	19.49
57	LGM	Peanut mottle virus-GN	3.5	0.21	147.3	138.7	0.91	1	1.51	19.70
58	RMP	Cons /demand studies		0.21	24.1	42.6	0.78	2	-	19.91
59	CRL	Drought-PM	8.9	0.56	65.3	116.7	0.48	3	1.48	20.47
60	GIP	Adaptability-GN	33.9	0.08	12.9	12.4	0.75	1	1.47	20.55
61	CRL	Adapt, to acid soils-SG	9.1	0.19	48.9	205	064	3	1.45	20.74
62	LGM	Peanut stripe virus-GN	4.3	0.18	97.1	47.1	0.54	3	1.40	20.92
63	RMP	Drought-SG/ PM/FM	8.1	0.14	32.1	12.4	0.65	3	1.40	21.06
64	CRL	Downy mildew-	168	1.12	64.1	114.6	023	3	1.39	22.18

		PM								
65	CRL	Drought-SG	8.6	0.85	31.4	229.7	0.76	1	138	23.03
66	CRL	Leaf blight-SG	50	033	37.4	52.0	0.86	2	1.37	23.36
67	CRL	Blast disease-FM	13.8	0.33	60.0	23.1	0.68	2	1.36	23.69
68	CRL	Striga-PM	4.8	0.33	10.7	31.1	0.66	3	1.33	24.02
69	CRL	Low grain yld-PM	10.5	0.87	55.4	93.6	0.32	3	1.30	24.89
70	LGM	Phyto. Bligh (MGT)-PP	15.9	0.12	103.9	147.4	0.01	3	128	25.01
71	LGM	Helicoverpa-PP	0.8	0.32	98.2	136.4	0.08	4	1.27	25.33
72	CRL	Foliar disease res.-SG	3.3	0.41	71.9	23.3	050	3	1.25	25.74
73	SMIP	Impr. of grain yield-FM	5.6	0.21	13.1	6.8	0.55	3	1.20	25.95
74	ECO	Res. Impact-SG/ PM/FM		0.12	11.9	4.6	0.48	1	-	26.19
75	ECO	Policy analysis-SG/PM/FM		0.12	85.7	34.4	076	1	-	26.46
76	CRL	Shoot fly-SG	12.4	0.27	45.6	67.3	0.49	2	1.19	26.46
77	CRL	Lack of adapt. (arid)-PM	9.9	0.66	20.5	68.7	033	3	1.18	27.12
78	LGM	Maruca-PP	1.9	0.06	52.5	102.4	0.11	4	1.17	27.18
79	LGM	Stunt virus-CP	1.1	0.10	88.2	107.9	0.25	3	1.13	27.28
80	LGM	Podfly (MGT)-PP	8.0	014	70.4	130.0	0.08	3	1.10	27.42
81	LGM	Water logging-PP	7.0	0.30	89.4	125.7	0.05	3	1.08	27.72
82	CRL	Podfly-PP	0.5	0.14	70.4	130.0	008	3	1.07	27.86
83	CRL	Head catepillars-PM	4.0	0.30	10.3	27.5	0.59	2	0.99	28.16
84	CRL	High temperature-PM	5.9	0.50	588	113.6	0.29	2	0.96	28.66
85	LGM	Cold tolerance-CP	7.6	0.23	20.2	66.1	0.03	3	083	28.89
86	CRL	Forage	99	0.25	842	72.3	0.28	1	077	29.14

		sorghum-SG								
87	CRL	Stem borers-PM	1.1	029	2.5	23.8	0.44	2	0.76	29.43
88	LGM	Botrytis gray mold-CP	29	0.19	30.1	82.8	0.48	1	0.74	29.62
89	ECO	Seed d'bution' SG/PM/FM	-	0.19	14.8	5.5	065	2	-	29.81
90	ECO	Seed d'bution-SG/PM/FM	-	0.17	205	10.5	0.72	1	-	29.98
91	RMP	Inst'l & human res'rces	-	0.12	75.9	114.1	0.00	4	-	30.10
92	RMP	Input markets	-	0.08	75.9	114.1	0.00	2	-	30.18
Complementary funding										
93	CQU	Quality/ Utilization-SG	36.9	0.13	185.7	169.2	0.79	3	2.68	30.31
94	RMP	Weeds	6.5	0.33	24.1	426	0.76	3	1.51	30.64
95	RMP	Weed (MGT) - SG, PM. FM	10.0	0.21	32.1	12.4	0.72	3	1.50	30.85
96	CRL	Acid soil adaption-SG	9.1	0.19	48.9	20.5	0.64	3	1.45	31.08
97	LGM	Aphids-GN	0.1	018	273	37.2	0.77	3	1.39	31.26
98	RMP	Nematodes-SG	2.2	0.09	5.8	1.6	0.53	4	1.34	31.35
99	LGM	Crop improvement-PP	2.2	0.83	230	14.5	073	3	1.34	32.17
100	CRL	Sooty stripe-SG	0.2	0.17	22.9	406	0.78	2	1.15	32.34
101	CRL	Long smut-SG	47	0.17	4.4	7.9	0.71	2	1.08	32.51
102	SMIP	Storage pests* SG.PM	0.1	0.12	17.3	9.7	0.48	3	1.03	32.63
103	CRL	Low grain yield-PM	5.5	0.21	11.5	296	0.32	3	1.00	32.84
104	SMIP	Ergot-SG	4.0	0.18	13.7	5.5	0.68	1	080	33.02
105	GIP	Imp. C' vars confec.-GN	8.2	0.17	3.9	3.0	0.55	1	0.73	33.19
106	SMIP	Photosensitive-PM	3.0	0.08	2.0	3.8	0.00	3	0.57	33.27
107	SMIP	Photosensitive-	3.9	0.02	3.6	3.8	0.30	1	0.39	33.29

		SG								
108	CQU	Qlty. Scre'ing-SG/PM/FM	-	0.17	173	7.1	0.54	1	-	33.46
109	COU	Q'lty imp'ment-SG/PM/FM	-	0.05	173	7.1	0.54	3	-	33.51
110	CQU	Sweet stern sorghum-SG	-	0.14	15.9	6.9	0.44	4	-	33.85

Appendix II. Illustrative sample of results of adoption/impact studies

Country	Crop	Variety	Region	Adoption (% area)	Impact
Botswana	Sorghum	SDS 3220 (Phofu)	National	14	Survey results indicate broad acceptability of variety for early maturity, large head and large white grain and strong stem resistant to lodging.
Cameroon	Sorghum	S35	Mayo Sava Diamare Mayo Danay	49 14 12	Yield gain (500 kg) maximum during drought years when yields of land races are almost nil. Widely adopted for early maturity.
Chad	Sorghum	S35	Guera Diamare Mayo Danay	38 27 24	51% yield gain; widely accepted for early maturity and food/fodder quality. Income generated through marketable surplus provides farmers means to invest in land conservation and improvement techniques.
India	Pearl millet	Improved cultivars	Maharashtra	92	
		ICTP 8203		34	50% yield gain; seed widely available via public seed sector; widely accepted for its downy mildew resistance.
		MLBH 104		23	61% yield gain; Rs 1,416 per unit cost reduction over local cultivars; Rs 2,670 per ha net returns.
			Gujarat	99	

		MH 169		33	Widely adopted due to
		MH 179		25	disease resistance, short
		Nandi 18		14	duration and high grain and fodder yield.
			Tamil Nadu	77	
		ICMS- 7703		6	Wide adoption due to high yield, drought resistance and seed availability.
		ICMV- **221**		5	
		WC-C75		12	
		Pioneer		29	
India	Pigeon pea	ICP 8866	Kamataka	59	IRR: 65%
			AP Border	52	US$ 62 m net present value of res. Benefits.
		ICPL 87	Maharashtra border	59	43% yield gains.
			Eastern Maharashtra	18	42% unit cost reduction.
			Western Maharashtra	57	Two main reasons for widespread adoption are: a) Short duration allows double cropping; and b) crop rotation with pigeonpea helps maintain soil fertility.
	Chick Pea	ICCV2	A.P.	17	IRR: 17.5-21 .2%
			Maharashtra	10	
			M.P	13	Gender: 11% higher employment. Sustainability: occupied rabi fallow land; (a) double cropping, (b) controls soil erosion, (c) improves soil fertility.
		ICC 37	A.P.	9	Yield increase: 111%
			Maharashtra	18	Gender: 8% higher employment.
		ICCV4	Gujarat (Jamnagar)	25	Yield increase: 67% Cost saving: 32%
	Ground Nut	Raised-bed & furrow	Maharashtra	31	IRR: 25.3%

	Prod-uction	Improved varieties		84	Gender: higher labour productivity; and easy weeding and harvesting.
	Tech.	Single super phosphate		69	Sustainability: moisture conservation and improve drainage.
		Zinc sulphate		14	
		FeSO4		6	
		Gypsum		42	
		Seed dressing		46	
		sprinkler		4	
India	Verti Sol Tech	Summer cultivation	Vidharbha, Maharashtra	75	Dry seeding: Cotton:
	.	Dry seeding Double		40	Yield increase: 27% Income increase: 55.7%
		cropping Improved		56	Cost saving: 17%
		Varieties Fertilizer		43	Sorghum: Yield increase: 38.45% Income increase: 98.5%
		Application (% farmers)		97	Employment increase: 13.6%
		Seed& fertilizer placement (% farmers)		95	Cost saving: 17.15
		Plant protection (% farmers)			
Malawi	Sorghum	SPV 351	National	10	Widely accepted for early maturity.
Mali	Peart millet	Improved cultivars	Segou	29	Stable yield improved food security.
			Koulikoro	20	65% yield gain
			Mopti	17	52% yield gain
	Sor-ghum	Improved	Segou	29	
		cultivars	Koulikoro	30	
			Mopti	33	

Mozam-bique	Sorghum	ICSV 88060	National	5	Drought relief programme distribution
Namibio	Pearl millet	ICTP 88908	National	31	Broadly accepted for early maturity, bold grain; basis for start of national seed industry.
Zambia	Sorghum	IS 23520 MR4/460 T11	National	35	IRR 11-15%, broadly accepted for early maturity and bold grain.
Zimbab we	Sorghum	ICSV 88060	National	36	IRR 22%, widely accepted for early maturity, late senescence, processing ease.
	Pearl millet	SDMV 89004	National	16	IRR 44%; widely accepted for early maturity and bold grain.

Source: TAG Secretariat (1996).

8 Institutionalisation of Research Management Tools

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1. Introduction

India has a long history of investment in agricultural research. It has already overcome the 'first generation1 problems of building a large and complex research system and training staff, but is still facing a number of 'second generation' problems related to agricultural research management, policy making and priority setting, and it needs to come to grips with a number of 'third generation1 problems. Now that agricultural research organisations have facilities and trained manpower, and have developed priorities and plans, their clients (farmers and processors) and stakeholders (the government, donors, NGOs and consumers) expect the national agricultural research system (NARS) to become more effective in the generation and transfer of appropriate technologies. In other words, they expect improvement in performance of the institutions, in the quality and relevance of the research programmes, and in the transparency of the decision-making processes. Third generation problems are partly the result of the rapid growth in the past, which in some cases has led to a situation, where agricultural research has become bureaucratic, characterised by top-heavy centralised decision making, a situation unfavourable to the innovation processes that are essential for agricultural research (Byerlee and Pingali, 1994).

The use of modern management systems and tools (such as priority setting, programme budgeting and management information systems) can make an important contribution to the improvement of research management (through improvement in the planning, monitoring and evaluation functions) and ultimately of NARS performance. But even through considerable investment in modern management systems has been made, sustained success has been limited. After initial success in implementation of new approaches to management, there is often a disappointment, followed by non-adoption.

This paper will present a discussion of the reasons behind the limited successes in introducing modern management tools. One of the main factors is that much emphasis has been given to theoretical, methodological and analytical aspects, while process aspects and institutionalisation have been neglected. Tool development has taken precedence over application and implementation. Only if a tool, technique or management approach is embedded in the research management system and if it is properly integrated with the larger policy and administrative framework, will it generate the information that is actually used to improve decision making.

The paper will start by developing an analytical framework that highlights the major issues in institutionalising management change. These focus principally on the social dimensions of the organisation and the conditions for successful change. The next section focuses principally on priority setting and management information systems (MIS) as special cases. The final section will attempt to offer some practical advice and draw some conclusions.

2. An Analytical Framework

Over the years a variety of research management and analytical tools have been introduced in the developing country NARS. Different priority setting and planning models, projects management tools, financial management and budgeting packages, databases and management - information systems, evaluation and impact assessment methods have been developed, adapted and implemented. International Service for National Agricultural

Research (ISNAR) and International Food Policy Research Institute (IFPRI) have played a major role in the development of these tools and methods, but are certainly not the only players. Major international accounting firms, for example, have developed financial management packages for NARS. In many cases, such modern management tools have been introduced in the context of donor funded projects with technical assistance from individual consultants, international organisations and private sector firms, supported by training, new computers, etc. The assumption has always been that the NARS would take over after completion of the special project, which in many cases has not happened. After initial enthusiasm, many organisations have found it difficult to sustain the momentum.

This limited success is not limited to developing countries nor is limited to the introduction of new management tools. Lasting organisational change, a characteristic of institutionalisation, is not nearly as common as some would like to claim. Caudron (1993) reports that two-thirds of American Total Quality Management (TQM) (Total Quality Management is a change strategy which focuses on human resources issues.) change programmes have failed. A survey reported in Champy (1995) indicates that approximately 70 per cent of private firms in the USA and Europe have run or are running re-engineering projects, and the failure rate of such projects is higher than 70 per cent. It is becoming clear that organisations are complex social constructs and changing organisations is a difficult task. When organisation consultants and scholars envision change they generally approach it with their own vision, which is grounded in their own disciplines, or are focused on the tool being introduced and only a few organisation specialists take on a more comprehensive approach. It is necessary to recognise this complexity and to approach organisational change in a more comprehensive way.

In trying to develop such a comprehensive approach to understanding organisations and ways to go about changing them, Bolman and Deal (1991) recognise four theoretical perspectives or as they describe them four frames. The structural frame deals with the allocation of responsibilities in organisations where the division of labour requires the definition of roles, rules, policies and management mechanisms to coordinate activities. The human resource frame is based on the recognition that organisations are inhabited by individuals with needs, feelings and prejudices; they have skills, limitations and great capacity to learn as well as to defend the established order. The political frame "views organisations as arenas in which different Interest groups compete for power and scarce resources" (p. 15). Conflict is always present and needs to be resolved through bargaining, negotiation, coercion and compromises. The final frame is the symbolic frame which draws heavily from cultural anthropology. In this perspective organisations are seen as having cultures with their own rituals, ceremonies stories, and myths which explain more than rules, policies and authority how organisations actually function. These different perspectives will be reviewed below to highlight what aspects are relevant to the introduction of a major management decision making system, such as a research management system:

The structural perspective

Organisational structure is often seen only as the organogram, which specifies where various positions fit with respect to one another. From Adam Smith through Taylor till very recently (Re-engineering questions this basic assumption and seeks to create teams that are associated with a complete product including some of its management, namely its quality control mechanisms.), the division of labour has been at the heart of increased productivity. This division of labour creates specialised units which need to interact fruitfully to achieve organisational goals. This calls for coordinating mechanisms which will ensure that individual efforts will lead to shared goals. Commands, supervision, policies, rules, planning and control systems are the principal vertical coordination mechanisms, while horizontal mechanisms would include meetings, tasks forces, committees, and special coordinators. The relative importance of these vertical and horizontal mechanisms is the prime characteristics of an organisational structure. Clearly the different research management systems are at the heart of an organisation's structure. They provide directions for the various teams and units, and collect information on achievements which may be viewed from a command perspective or as an organisational learning tool to achieve greater performance.

Research on organisational structure suggests that it depends on a large number of variables such as size of the organisation, its core technology, its environment, its information technology, and the nature of its work force.

The introduction of a research management system or its modernisation constitutes a significant change in structure of the organisation, namely, in its coordination mechanism. Also, different organisations will be affected in distinct ways. Planning, for example, will vary across organisations depending on their objectives, and their core technology. The more applied regional research organisation will seek to involve its users in its planning more than fundamental research institutions for which the demand is derived from the front line institutions. Larger institutions will need to establish full time positions to do the priority setting, monitoring and evaluation (PME) function and these will need to be related to other units through appropriate line or staff relationships. Moreover, modern information technologies enable a much easier and more widespread circulation of information. This means that decision making can be decentralised much more and vertical coordination can be enhanced often at the cost of several layers in middle management.

Many NARS will be subjected to dramatic changes which will increase the differentiation of institutions within the NARS. Globalisation and commercialisation will make some institutes (e.g., in horticulture) more responsive to the private sector. The increased focus on poverty alleviation and the emphasis on environmental concerns will affect the organisation of other institutes significantly, as will the arrival of new technologies in advanced breeding and molecular biology. This increasing differentiation will require a tailoring of the research management systems to local conditions. Organisational goals and planning methods will differ in each type of institution. In fact, the technology proper of each type of organisation should differ significantly calling for more multidisciplinary efforts in the regional organisations than in the basic research organisations, complicating singularly the planning and evaluation process.

Organisations will grow more specific by developing appropriate structures, which may change across the systems. This means that research management systems should be allowed to vary considerably at least across the various types of institutions that will emerge.

The human resource perspective

In this perspective, organisation can reach higher levels of performance by seeking harmony between the needs of the individuals and those of the organisation. This puts a great emphasis on understanding the needs of individuals. Argyris (1964) and McGregor (1960) argue that traditional management focuses on satisfying only the lower needs of employees, whereas participatory management calls on higher level needs such as self actualisation which can unleash higher levels of motivation and capacity. This is the principal argument for suggesting greater empowerment as a means to greater performance (This argument may be less relevant in developing country organisations where concerns over basic issues such as remuneration come before higher level concerns such as self-fulfilment.).

This frame is important in examining the positive and negative consequences of the introduction of an improved research management system for the motivation of staff through improved or reduced fit between the needs of individuals and those of the organisation. Obviously, if the objectives of the organisation regarding this new system are not properly understood by staff, or clash with the perceptions of staff, it may generate negative reactions that will inhibit its implementation through inaccurate and untimely data reporting, leading eventually to its abandonment. Moreover, the training required at all levels to implement the system, will be greatly enhanced if the additional learning meets the need of the staff.

Significant involvement of staff in the design of new systems involves empowerment. It is important to note that this is very different from consultation where staff are merely asked to give their opinion. Staff and management must reconcile their mutual needs and design a system that incorporates the safeguards required by all parties. The consequences of this approach in terms of time and money should be obvious, but that may make a difference between a working system and one with meaningless data of no practical use for decision making.

The political perspective

In this view, goals, structure and policies of an organisation emerge from an on-going process of bargaining and negotiating among major interest groups and coalitions. Organisational change requires that managers recognise the political realities in organisations, who can fashion a change agenda, build networks for support and negotiate effectively with those who may advance and those who may oppose the agenda. It basically amounts to a Machiavellic exercise of power, and when participation is used, it is more in the form of co-optation rather than genuinely trying to match needs of individuals and organisations. This vision very much epitomises the idea that in any change there are winners and losers.

The cleavages foreseen in any change process can vary widely according to the nature of the change. For instance, a process to make promotions more performance related would induce a coalition of those who benefited from promotion based on seniority, most likely the older staff, against those seeking a more dynamic process based on individual output, more likely to be the young currently frustrated in their promotion perspectives. This could degenerate in a generation clash where the problem is not solved and organisational dynamics suffer. Another issue such as the introduction of an improved research management system will give rise to entirely different coalitions.

It is important to anticipate the interest groups that will emerge with the introduction of a transparent research management system so that strategies can be designed to understand their reasons and allay their worst fears through proper communications and to close the gap between the different coalitions. In the best of cases the computer specialists who are advising on the choice of software and hardware will be seeking the best design in terms of database principles and will try to incorporate their vision of the future, not always paying attention to the interests of decision making. A worst case would be that they intentionally keep the system as complex as possible to increase their power over decision makers.

Decision makers also constitute complex groups with best and worst cases. There are those who wish to have a transparent process for decision making so that an institutional memory is created to enhance institutional learning (human resource perspective), those that want increased control on activities (structural perspective) and those that do not want to have such a transparent process since it would increase their own accountability to stakeholders.

Finally, the scientists whose activities will constitute the basic information in the research management system may be divided into those who fear the increased control on their activities, and those who want to have greater transparency because they are unsatisfied with the current resource allocation.

These various groups cannot be divided neatly into those who are for and those against the desired change. In fact, in between these extremes one should expect to find a number of groups supporting more or less the change depending on how strong they feel about the issues. Once the political realities are reckoned with, then strategies can be designed to build networks for support, to find the common denominator, and to negotiate effectively with those who might advance the change agenda and those who might oppose it. In fact, once problems such as reduced funding are finally shared by all concerned, and higher organisational and individual performance are seen as a means to overcome this constraint, then the need for transparency may become the unifying factor of several of the groups indicated above.

This cynical view of change stemming from the political perspective has the merit of highlighting the need to recognise some of the forces in the change process, and it is particularly important to note with an organisational change involving management information which will be seen rightly or wrongly as an instrument of power in the controlling hands.

The organisational culture perspective

Defining organisational culture is difficult and it should suffice here for our purpose to use the description provided by Bower (1966) as "the way things are done around here". It is not operational but it does convey the general idea without getting into lengthy discussions. Organisational culture takes the shape of symbols, rituals, myths and metaphors.

According to Bolman and Deal (1991), the basic assumptions to organisational behaviour in the cultural perspective are the following:

- What an event means is more important than what actually happened;
- events can have different meanings for different people;
- many events in organisations are ambiguous or uncertain;
- the greater the ambiguity and uncertainty the harder the use of the rational approaches to problem solving;
- symbols are created to reduce confusion, to increase predictability and provide direction; and
- many organisational events are more important for what they express than what they actually accomplish.

The principal functions of organisational culture are to define who determine standards of behaviour in the organisation(?), to provide a sense of identity to members, to help in generating commitment and to enhance social stability within the organisation. Basically, these functions contribute to give some meaning to events that escape rational explanation and reduce uncertainty in processes where the connection between cause and effect, or goals and activities is largely conjectural. On this basis cultural "explanations" are very significant in understanding the behaviour of public agencies, educational, research and health care organisations.

An illustration of this would be the maintenance of staff performance appraisals in public institutions in spite of the fact that they rarely produce any learning or useful information about employee performance, or the continuation of management training in either private or public institutions which produces little improvement in managers, skills but contributes to the socialisation of managers into the management culture. The rituals provide some function in the sense that it reassures staff and outside observers that the organisation is doing something about staff-performance and management training.

In an organisation with a strong culture as observed in the cohesiveness, loyalty, and commitment of its members, we should expect greater behavioural consistency, reducing the need for formal rules and procedures to regulate staff activities. In this sense, culture complements structure.

The introduction of a new or improved research management system may increase the feeling of uncertainty and staff will tend to switch to the automatic pilot provided by the organisational culture with the resulting resistance to change. This may be compensated by a proper communication strategy to reduce the perceived meanings of the proposed change, and principally by a genuine invitation to participate in a game of change where staff will be the principal actors. This means dramatising the anticipated change and seeking their active participation in an exciting project to improve performance. This argues in favour of a gradual approach to reduce the inevitable uncertainty and confusion associated to such a complex process of change.

Planning and MIS as socio-technical systems

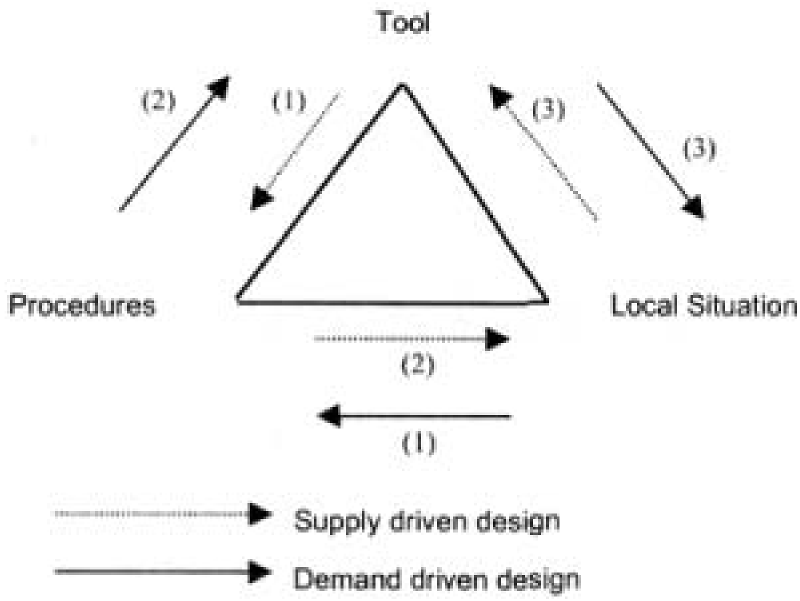
The complexity of organisations and the lack of an adequate integrated theory to explain their behaviour suggest that a more eclectic approach drawing on different perspectives and theories be used in designing the change process. The institutional change processes required for the successful introduction of new management tools and systems have been seriously underestimated and ignored, partly because organisational change processes are not well understood. Yet, an understanding of these processes is fundamental for sustained success. Hofstede (1994), in his review of budgeting processes in manufacturing firms, concludes that budgeting is much more than an administrative technique; it is a way of managing. Budgeting is a socio-technical subsystem of the management and problems emerge from the social rather than the technical problems involved.

Three sets of factors seem to be relevant in explaining the successful adoption of a new management tool, two of which are well grounded in the literature on organisational change: the tool itself, the local situation and implementation procedures which should ensure that the tool is adapted to the particular circumstances of the organisation in which it is to perform. Figure 8.1 shows that to be successful the tool itself has to be valid, but each different local situation requires that the implementation procedures are adaptable. In other words, tools need to be tailored to local situations. This implies that the causes of. failure to institutionalise a tool may be found in each of the three elements. Tools may be inherently of poor design and low quality, lacking rigor and consistency, and therefore, failing to measure or to accomplish what they are meant to. The local situation may be improperly understood in itself and in terms of the expected responses from the organisation to the introduction of the new tool. Insufficient attention may be given to adapting and tailoring the generic tool or method to the needs, requirements, capabilities and social fabric of the specific organisations.

Figure 8.1 illustrates that system design may start in any of the three corners of the triangle. ISNAR's INFORM work and the ISNAR/IFPRI priority setting work using economic surplus analysis started from the tool development side and were largely supply driven (Economic surplus analysis essentially started form the application of social cost-benefit analysis to research investment decisions. INFORM was partly driven by the possibilities offered by personal computers and user-friendly software to provide relevant and timely information to research managers.). Alternatively, one may start with an assessment of problems and needs in specific local situations and start the tool development from there; this has been the case of ISNAR's work in Latin America on Planning, Monitoring and Evaluation. Where models or examples from elsewhere are available (e.g., financial management system), the starting point may be the adoption of implementation procedures to the local situation. There is no evidence that one approach is more effective than other in achieving sustained adoption of new systems, but it is clear that all three corners of the triangle need to be visited in the course of system design.

Elaborating on these basic principles, experience has shown that institutionalisation of research management tools mainly depends on issues of integration: technical and social integration. Capacity is also a limiting factor affecting both technical and social integration.

Figure 8.1: Using research management tools.



Technical integration: The framework presented in Figure 8.2 shows that, to be effective, tools have to be used in the research management cycle that consists of planning, priority setting, budgeting, monitoring, evaluation and impact assessment. Integration is a major factor in the successful implementation and institutionalisation of research management tools. It is needed in at least four ways. First, between the tool and the management function or process: information needs to be used to improve decision making. Second, there is a need to produce information in a timely manner, taking into consideration, for example, existing budgeting and cropping cycles. In many countries there is no congruence between the two, and management systems have to be able to deal with this. Third, management systems need to be capable of integration across different regions and ecosystems and produce output relevant at different levels. Finally, and similar to the previous point, there is a need for integration across institutional hierarchies: systems need inputs from and should be capable of producing relevant outputs at the levels of programme, station, institute and NARS. The last two points are particularly relevant for a large and complex NARS as in India.

An analysis of the different organisational levels is particularly important as the nature of the decisions varies. At the highest level, overall policy criteria are most important, while at the level of programmes, projects or institutes, technical criteria are more dominant factors in decision making. In India, at the national and sectoral level, the Ministry of Agriculture, the Department of Agricultural Research and Extension (DARE) and top management of the agricultural research system (ICAR) decide on major policy and board resource allocation issues. At the state level in India, the State Agricultural Universities (SAUs), and the State Departments of Agriculture play a major role in agricultural research. The SAUs obtain an increasing share of their funding from ICAR, contributing to the centralisation of the system. The programme level in India includes a wide range of activities. The All India Coordinated Research Projects, the Project Directorates and the national and central research institutes have a mandate for nation-wide research and, in effect, coordinate and implement research programmes that deal with a commodity, a sub-sector, or an agro-ecological zone. Technical considerations become more important in decision making at this and lower levels. At the institute and station level, the agreed priorities are refined and their implementation scheduled over time in accordance with resource availability.

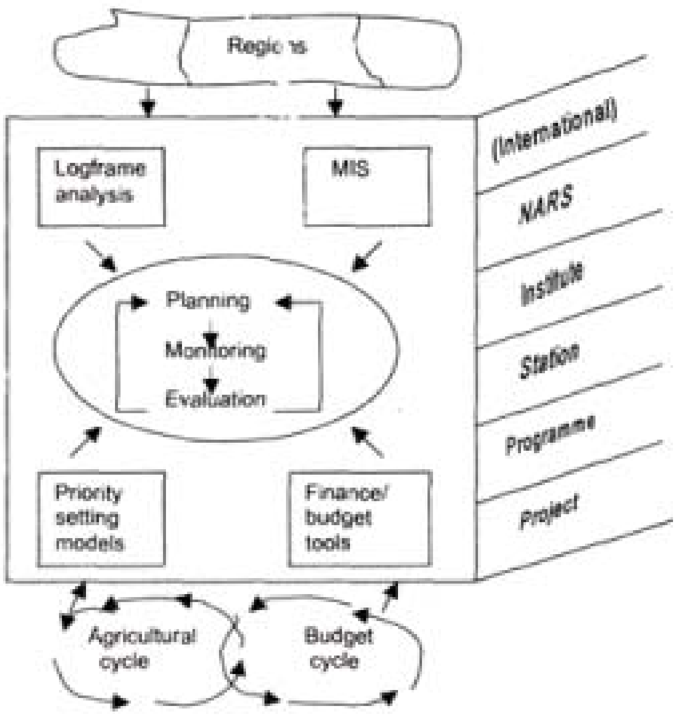
Social integration: Such integration deals with measures like initiative implementation, executive support, shared understanding and urgency that seek to increase the ownership of the new management tool.

In many cases the initiative to introduce new management tools in a NARS comes from outsiders. Traditionally, the government as a major stakeholder has placed a number of administrative, budgeting and reporting requirements on the public sector research organisation. Usually, these practices are geared towards control and they do not take into account the specific nature of agricultural research organisations, and therefore, are not of much help in strengthening research management.

Donor funded special projects have often been used to introduce management practices aimed at improving the quality of research and resource management. In many cases the implicit assumption has been that improved management tools would sell themselves and be adopted 'NARS-wise.1 In practice, it has become clear, however, that 'mainstreaming' special initiatives is a very difficult issue.

The implementation of improved research management tools and practices relates to the question of who carries out most of the work: outsiders or insiders. The more complex the exercise or tool, the more the limited possibilities for decision makers themselves to engage in the work in a meaningful way. External consultants or analysts then do bulk of the work (data processing, analysis and reporting); decision makers may no longer be able to follow exactly what is going on, a situation that will affect the credibility of the exercise. Participation in the design, adoption and implementation is, therefore, of the utmost importance.

Figure 8.2: Integration or research management tools



A related factor is the issue of executive support. New tools and approaches can require major change in an organisation, and there will always be some resistance. The clear support of senior management is essential to the success of introducing a new system. This support in turn requires understanding and ownership.

Finally, not only top-level support is needed, but also an understanding throughout the organisation is essential to ensure institutionalisation. In large organisations different subgroups have different perspectives and information horizons. What may seem obviously important to senior managers, may appear to be a meaningless exercise in bureaucracy to the researchers who have to provide the data.

The idea of urgency relates to the observation that suffers because of the new tools and approaches do not seem to address the most important information problems faced by research managers. They are usually overwhelmed by requests for routine administrative information to be provided to the Ministry of Agriculture, the Planning Commission, the Ministry of Finance, other government agencies and a variety of external donors that all have different information requirements. The analytical and management information provided by priority setting and management information systems, for example, are often seen as interesting, but some additional information needs to be collected and provided urgently to external agencies. The analytical information to improve agricultural research management is mainly used internally; it is not demanded by outsiders (except in some cases international donors). Internal uses of such information need to be developed. In particular, it is important to design specific uses of the information in the events such as programme planning and review meetings. The real challenge is to develop high priority uses for the new management tools, so that after some time research managers will find them indispensable.

Capacity: Even if tools are not too complex to be used in a given situation, training and equipment will be needed for national staff to be familiar and confident in the use of the new methods. If the tools continue to depend on outsiders for problem solving or even routine operation, the chances of their taking root are small. A core of national staff needs to be trained in sufficiently large numbers to ensure continuation allowing for staff transfer and attrition. Specialised support (e.g., computers and software) should be with local firms as much as possible.

3. Research Management Functions and Tools

A large number of research management and analytical tools are available to support different research management processes. Table 8.1 provides a summary of the most important tasks to be accomplished by research managers. In practice, not all of these tasks receive equal attention or weight in research management. Some are seldom or never performed, while others are done in a highly informal manner (which is not necessarily a bad thing). The remainder of this section will discuss two tools in more depth, viz. priority setting/planning and management information systems.

Planning and priority setting

Both planning and priority setting can be seen as processes that use tools. Alternatively, priority setting can be seen as a tool that supports planning, depending on the detail of the analysis.

Table 8.1: Management tasks, frequency performed and tools used

Task/Function	Frequency	Tools
Planning	***	Planning models, Logframes, Rapid appraisals
Priority setting	**	Economic surplus analysis, Scoring models
Project appraisal	*	Logical frameworks
Monitoring	***	MIS
Reporting	***	Formats
Evaluation	**	MIS, CIPP, Economic analysis
Impact assessment	*	Economic analysis

***, high; **, medium; *, low.

The discussions on priority setting have focused almost exclusively on the methods used. The analytical approaches fall into two major groups, viz. scoring methods and economic surplus analysis. The debate on the merits of each has become somewhat less heated in recent years as the information required for economic surplus analysis have become easier to handle. On the other hand, multiple criteria scoring models have incorporated the efficiency measures that economic surplus provides into scoring models (Kelley et al., 1995).

The choice of a method is an important issue in the priority-setting processes, but it is only one of many issues that have to be addressed. This section will not discuss issues of methodology which has been covered extensively in the literature (Alston et al., 1995). Instead we will present some of the issues related to the process of priority setting and planning and its institutionalisation. In these areas less progress has been reported as compared to the developments in methodology. Yet, improved understanding of the institutional context, processes and mechanisms is fundamental to the success of priority-setting exercises.

Priority setting provides information to improve decision making. In practice, however, few priority-setting exercises result in verifiable changes in resource allocation. Information seems to have limited influence on actual priorities and priorities have little influence on actual resource allocation (Mills, 1996). For priority setting to result in improved decision making, the exercise needs to be integrated in research management process planning, monitoring and evaluation.

If few priority-setting exercises result in improved decision making, there must be other reasons why organisations periodically engage in such activities. Experience suggests that priority setting and planning exercises play a number of additional roles. First, priority setting is often done to achieve consensus at the institution about the course to follow, satisfying different interests, rather than optimising the research portfolio seems to be the objective. Second, priority may help to focus on the lack of information needed to make informed decisions. It is often an opportunity to collect relevant data that would be unavailable otherwise. Third, an important role of priority setting is to project to the outside world the importance of research to address urgent problems in agricultural development. Fourth, a set of agreed priorities is a powerful defence mechanism against outside interference. Research organisations are continually under pressure from many sides to pay attention to problems that are high on the list of a variety of stakeholders. While agricultural research organisations need to be responsive to the needs of clients, they also need focus and stability. A transparent and credible set of priorities helps to convince outsiders that the institute knows what it is doing and is focusing on important issues. Finally, priorities and plans are essential to convince the donors to provide funding.

If a well defined and carefully argued set of priorities is important for any research organisation and if priority setting needs to be tightly integrated in the research management functions, it is important to develop a system that integrates priority setting particularly in the planning process. Based on the ISNAR work in Benin, Janssen and Kissi (1996), following earlier work by Collion and Kissi (1995), have presented an eight-step integrated planning and priority-setting approach. The emphasis here is on planning as obvious from the list of steps.

1. Review of the research "domain"
2. Constraint analysis
3. Evaluation of existing research results
4. Determination of research objectives and strategies
5. Identification of research projects
6. Priority setting among research projects
7. Human resource gap. analysis
8. Recommendations for implementation

Priority setting in this case is only one step in a much more comprehensive process of programme planning. The advantage of this approach is that priority setting is seen as integrated in institutional processes and not as an isolated exercise. For each of the steps an assessment is then made of the following aspects (Janssen and Kissi, 1996):

- **Rationale:** Why a particular step is needed in priority setting?
- **Output:** The results to be obtained from this step (e.g., 'a coherent list of objectives').
- **Responsibility:** Who is to deliver the outputs (e.g., institute director, planning unit)?
- **Participants:** Who will be involved in this step (e.g., farmers, researchers, etc.)?
- **Information needs:** The information required to complete this step successfully.
- **Methods:** e.g., field surveys, rural appraisals, interviews with researchers, etc.
- **Time and resource requirement:** Staff, funds, vehicles, etc.

Specifying the activities in a step-wise fashion and indicating what is needed to complete each step, this framework deals with tools and process in an integrated manner.

Management information systems

An MIS for agricultural research consists of one or more databases and an accompanying set of procedures, which provides relevant and timely information to a variety of users (research managers, directors, programme leaders and scientists) on the implementation of research activities (programmes, projects, experiments) and on the use of resources (scientific and support staff, funds, equipment, inputs, etc.) in the research process.

Most agricultural research institutions already have one or more information systems: lists of personnel, payroll data, lists of projects, experimental protocols, annual reports, etc. In most cases, these information systems are not linked to each other in an integrated manner, making it difficult to use the systems for management purposes. A modern integrated MIS, on the other hand, can be used as a decision support system by managers and directors, and it also provides information to scientists and interested parties outside the institute.

The MIS can be more or less comprehensive in scope depending on the number and variety of categories of information included. A comprehensive MIS would include all relevant information on personnel, finance, facilities and equipment and research projects. Most of the operational MISs contain only a part of this information, because, in practice, the more comprehensive and inclusive the system the more difficult is the management. Flexibility would favour a system with different databases for research projects, staff and finance which can be linked using database technology.

An MIS can be used and maintained at different levels. It can be set up and managed at the level of individual organisations and institutes only, or it can be a national system that integrates information from different institutes into a national database that provides information to decision makers at both institute and national level. The latter system requires a national level planning and control effort to ensure consistency and compatibility of institute level information systems.

Since the late 1980s, the ISNAR has set out to design an MIS for agricultural research management that recognised the power of the newly available personal computers and easy-to-use software to improve the information base for agricultural research in a decentralised manner. The INFORM system that was developed and tested through collaborative work with the Sri Lankan NARS, was later disseminated to large number of Asian NARSs using amongst others training workshops at National Academy of Agricultural Research Management (NAARM) in Hyderabad.

The core of the INFORM methodology is the integration of information on research programmes and projects, finance and personnel. Earlier versions of INFORM were set up using flat-file databases, but since 1994 a new relational INFORM-R version has been developed using Microsoft Access as the database software. This new implementation makes the programme easier to use and reduces the training requirements. INFORM has been implemented with varying degrees of success in more than 20 developing countries (Nestel, 1996). In some countries where the ISNAR has given ample support, results have been disappointing. In others the system is in use without any significant support. In India, NAARM has been involved in INFORM for a long time. It has trained a large number of people and has produced several publications (Balaguru et al., 1996). Longer term institutionalisation, however, has been limited. There are a variety of reasons for this, three of which are discussed below. They have to do with the tool itself, with the changes it introduces in research organisations and finally, with the adoption to specific local situations.

Some aspects of the INFORM methodology have caused problems. In particular, its handling of finance and programme budgeting, using account codes relevant to agricultural research but unfamiliar to many research managers, was too cumbersome. Also, its use of staff time as a proxy for resource allocation was not always understood. These points brought out by an external review have been amended. It appears that many NARSs as research oriented public sector organisations, and with rather limited skills in management and financial analysis, were not ready for the type of changes that INFORM demanded.

The INFORM also represents a major change for most agricultural research organisations in the sense that it introduces a transparency which makes it possible for many people to see who is doing what and where. As knowledge represents power, the INFORM can be a major threat to the traditional power structure in an organisation. This has been seen in a number of countries implementing the INFORM where the initial enthusiasm has cooled as managers began to recognise the power of the new tool (Nestel, 1996). In many cases, therefore, pressure for introducing the INFORM has come from donors who seek better financial and programme information from research activities that they are funding.

Another factor that has likely contributed to limited institutionalisation is the fact that INFORM's design has been supply-driven. Much attention was given in the early stages to methodology and database development. This was clearly a necessary phase, but the adaptation to specific local situations has not always happened. To a large extent, this is caused by ISNAR's limited capacity to provide country specific follow-up. Increased reliance on national consultants and software developers is an important strategy for the countries having skills in these areas.

4. Conclusions

The main issues discussed in the paper are summarised below:

1. The introduction of an important new management tool entails significant institutional change - a process that has often been neglected in the design and implementation of new approaches to research management.
2. The discussion regarding priority setting has been dominated by concerns over the methodologies to be used. More attention is needed to the planning, budgeting, monitoring and evaluation processes that priority setting and other tools are supposed to feed.
3. The process of tool design and implementation may start with the tool itself, with a need assessment and proper understanding of the local situation or with the procedures needed to adapt an existing instrument to a particular institution. The process can start anywhere, but it is important that all three elements be included in the process. Generic tools need to be tailored to the needs of institutions, based on a thorough diagnosis of the current situation.
4. New management and analytical tools provide information, but often information does not affect priorities, and priorities do not affect resource allocation. One reason is that available baseline information on current resource allocation (budgets) is not meaningful from a programme point of view. It is then difficult to decide if resource allocation is following programme orientations. Another reason is that the tools are often not well integrated in research management processes.
5. To be successful, new tools or management approaches need to be of high quality, address urgently felt information needs, be closely integrated with research

management processes and be owned by the organisation. It is essential that the need for the new tools be genuinely felt by decision makers.

6. The integration of management tools with planning, monitoring and evaluation processes is essential to ensure that the information generated is actually used to improve decision making. Design should include the use of outputs in organisational reports and events such as programme reviews. Similarly, research directors may need to be educated on the use of analytical information to improve decision making. New tools need to focus on urgent information needs of research managers.
7. Research management systems should be integrated with agricultural and budgeting cycles and facilitate aggregation of information across different types of regions and institutional hierarchies.
8. Ownership and participation are crucial to the longer run success of any new management system. These systems should be designed primarily with internal information demands in mind. It has often proven difficult to internalise systems that were originally developed for external accountability demands.
9. Management tools aim to optimise the use of staff and funds in specific programme activities, usually to improve efficiency. This objective should be made clear to all staff early in the process to reduce apprehension about a hidden agenda. The political dimension of research management and priority-setting processes is often neglected. Uncertainty of research outcomes, limited possibilities to shift resources and vested institutional interests would argue in favour of a 'balanced portfolio approach1 instead of investing heavily in the most optimal set of activities.
10. It would be difficult to implement successfully a PME system merely to fulfil transparency obligations, which may be imposed from outside rather than felt from within. It may suffer the indifference of both management and staff who are to feed information to the system, and will generate interest only among those responsible for its implementation, often information technology specialists.
11. Involve senior management in the design process to ensure that the new tool will be well integrated in the decision-making process, and that executive support will be available when important decisions in design and implementation are required.
12. An overall conclusion is that given the complexity of the change process, the time and resources allocated to the design and implementation of a new management system should not be underestimated.

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9 Institutionalisation of Research Priority Setting in Indian NARS- Issues and Approaches

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1. Background

Investment in agricultural research cannot be immune to evaluation and economic efficiency like any other investment in an economy. As the resources become scarce, assessing the efficiency of research investment becomes more important. Though there is wide awakening on the importance of agricultural research priority setting among players of international agricultural research, the activity has not received due attention within national agricultural research systems (NARSs), particularly among the developing countries. Recently, some exercises were undertaken in this area in few Asian countries.

Although research in agriculture and allied fields is growing in India, it needs much of commercial characteristics and improvement in system's efficiency. Institutional inefficiency could partially be attributed to the fact that agricultural research is in public domain and the inherent inefficiency of public sector enterprises afflicts agricultural research system also. Now, there is a growing demand from the society on the contribution of agricultural research, and the efficiency with which public funds are used in the research system. The demand for research is also expanding because there is: (i) a definite need for ensuring food and nutritional security to the growing population, (ii) an expanding sector of food and agro-processing, (iii) substantial expansion in agricultural exports, (iv) serious concerns for environmental and sustainability problems, and (v) because the liberalised economic environment has set in new demands from agricultural and allied sectors.

The growth in the resources set apart for agricultural research in the future may not be commensurate with research demands, as other investment options competing for public funds are expanding manifold. In other words, the NARS has to operate in a much more cost-effective manner. This calls for an institutional" mechanism within the NARS that ensures efficient utilisation of available resources. This paper develops a framework to institutionalise the mechanism for research priority setting in Indian NARS, and discusses issues relating to priority-setting methodology and outlines.

2. Methodology

Although fairly sophisticated methods are now available for ex ante and ex post research evaluation, there are some methodological issues which are yet to be addressed or refined. For example, the change in yield resulting from the adoption of high yielding varieties (HYVs) has been the central variable in most of the impact assessment studies. Many new technologies, however, are adopted by farmers not because these increase yields, but because reduce costs, improve product quality, or can be planted at different times in a year. Such technological improvements may generate substantial benefits for producers or consumers even if they are low yielding (Horton, 1986). These benefits in many cases have not been captured adequately. Furthermore, for impact assessment, more detailed knowledge of farmers physical and socio-economic environments, decision-making processes and perceptions about technologies is needed than what has generally been recognised.

Biases in estimation of benefits often arise. One such source of bias stems from the fact that yield measurements on small experimental plots generally exceed those on large fields even when the same technology is supposedly used. Second source of bias comes from the methods used by researchers to reduce sources of variation among experimental inputs at assumed 'normal' representative levels.

There is a need for documenting demand and supply elasticities for various commodities available across the country. Estimates are sensitive to errors in data and also methods used. Sometimes lumping of products such as 'miscellaneous', 'minor foods', starchy foods, vegetables and fruits, does not give the right estimates of elasticities. These foods often play a quite different role in the diet. Some items in the group are elastic and others are inelastic. Consequently, no single elasticity can reflect the true association between price changes and the level of consumption of any one of the food items in the miscellaneous category.

It is easier to assess the impact of a new variety. We are less clear in quantifying impact of new pest management methods, seed systems and farming systems despite the fact that they are well understood.

Obtaining precise values for probability of research success in ex ante analysis is formidable because the judgement of researchers varies considerably. Eliciting values from senior researchers who have worked in the area (say rice bio-technology) may prove to be more reliable instead of judgements from more number of less experienced researchers or from those who have not used the particular approach or methodology. To cite an example, not all plant breeders are familiar with bio-technological approach in breeding new varieties.

These are several grey areas in impact analysis like research lag, shape of adoption path, competitiveness of markets, separate contribution of research and extension to productivity, impact of an institution, and economies of size in research. (Mullen and Cox, 1995 and Wise, 1996). An understanding of these issues and their explicit consideration in analytical model would help validate ex ante analysis, thereby improving priority-setting process.

3. Collaborative Research

Developing countries could save substantial amount of money if they promote more collaborative research among research institutions within the country and with their neighbours. Collaboration could lead to even greater benefits by speeding up the development and adoption of new technology. Three types of cost savings may occur from collaborative research within and between NARSs. First, less laboratories may be needed to achieve the same research output. Second, each laboratory may produce results more rapidly through collaborative research. Third, it may be cheaper to do Ph.D. and Masters degree training in the NARS of developing countries than in U.S.A., Japan or Europe (Pray, 1994).

It is important that economists undertaking research evaluation work and agro-biological scientists must have close interaction. This interaction may help focus research objectives as ex ante evaluation leads to formulation of new projects. Also, scientists may realise the types of information required for evaluations and tend to collect this as project proceeds.

Research organisations must encourage successful collaborations among institutions. At present, scientists working on similar lines are ignorant of activities of each other resulting in duplication of efforts. One of the goals of priority setting effort is to encourage collaboration among agricultural researchers and organisations to minimise research costs.

4. Institutionalisation Mechanism

In the recent years, there is a growing realisation of the need for priority setting in agricultural research both nationally and internationally. There are already some efforts made in this direction in India (Jha et a/., 1995; Ramasamy et al, 1994; Ramasamy et a/., 1997). In the contemporary NARS, the critical phase is to integrate the priority-setting activity at three stages of hierarchical structure, viz. national, state and zonal. An institutional mechanism integrating these three levels of priority setting will have far reaching effects on Indian agriculture. An institutionalisation framework for the three levels is discussed here:

National-level: Though agriculture is a state subject, the Union Government gives the broad directions and sets the goals for Indian agriculture. The Indian Council of Agricultural Research (ICAR) is an apex body responsible for organising agricultural education and research, and formulating policies and designing programmes relating to agricultural research. But a number of other national bodies (e.g., Council of Scientific and Industrial Research, Department of Science and Industrial Research, Department of Bio-technology, Department of Science and Technology, University Grants Commission, Ministry of Energy and Environment, Department of Non-Conventional Energy, Central Water Commission, Wasteland Development Board, Ministry of Rural Development, etc.), also either fund and/or undertake research in agricultural and allied fields. Overlapping of funding of research activities across these organisations is conspicuous. National level co-ordination of private and public sector research is needed. In the absence of formal interface with the private sector, there could be a duplication of work. A national level co-ordination committee on agricultural research with the Director-General of ICAR as co-ordinator and key decision makers from these bodies may be constituted. This committee should set broad research priorities and rationalise allocation of funds to research organisations in the country. Inter-institutional linkages will enable independent institutions to influence each other's agenda. This exercise may eliminate overlapping of research, and prudently guide allocation of funds across basic and applied research and across broad research problem areas and disciplines. Effective enforcement of suggestions of the Co-ordination Committee may not be possible but the committee may create a culture of partnership among funding bodies and agricultural research organisations across the country. The directions and guidelines of the committee may be communicated to all the state governments and state research organisations, emphasising the importance and relevance of agricultural research priority setting. The ICAR may continue to clear funds from foreign agencies/donors, and allocate them to priority research areas. This kind of effort has already been made in the Philippines (Bantilan, 1994). The National Committee may indicate clear mandates for research institutions which may take up different research areas.

State-level: At the state level, nearly 80 per cent of agricultural research funding comes from the state governments. This applies to most of the states. Similar to the National Agricultural Research Co-ordination Committee (NARCC), creation of a State Agricultural Research Co-ordination Committee (SARCC) under the chairmanship of the Vice- Chancellor of SAD will be useful. At the state level, besides SAUs, a number of departments in general universities, ICAR institutes, institutes of other national bodies, private sector and in some cases, State Department of Agriculture, Horticulture, Seed Certification and Cooperation, Agricultural Marketing and State Academy of Science and Technology, take up research or provide funds for agricultural research. The committee must be represented by all these institutions and broad research problem areas may be identified, and overlaps and misallocation can be minimised by free exchange of ideas, discussion and mutual agreements. The SARCC may convene meetings once in a year and sufficiently provide time to discuss all the issues.

An expert cell with a senior agricultural economist as the head may advise the SARCC. The expert cell may develop a rigorous framework of research priority setting and propose the priorities considering the national and regional goals. The SARCC may identify research problem areas and the institutions to address these priority areas. The Committee may bring the individual institutions together to exchange ideas, materials and methodologies.

SAU-level: A research priority setting unit headed by a senior agricultural economist at the Directorate of Research may take up priority setting at the SAU-level. The unit in collaboration with the Regional Research Stations (RRS) may plan research for the university and for the RRS. It will be an annual exercise. The unit will consider all the discussions and suggestions made in the meetings of the Research and Extension Councils, Regional Research Councils, Scientific Workers Conferences and Farmers' day, and national and state policies in drawing research plans at SAU-level. One issue often raised is that at RRS there is always a competition for resources between seed production and research activities. The priority setting exercise should help resolve this issue.

The organisational structure at the SAU-level includes several RRS. In SAUs, there is no adequate co-operation between RRSs often leading to duplication of work. Researchers at RRS are also many times ignorant of similar work being done elsewhere. A three-member priority setting unit with RRS Head, one social scientist and a biological scientist may undertake the priority setting work at RRS. These units may coordinate with the central unit at the Directorate of Research and develop research plans for the RRS. The central unit can help avoiding repetition of research at different RRS. The unit at the directorate level may take up capacity building programmes, budgeting and time scheduling of projects. The SARCC's guidelines to SAUs will help focus research on those problem areas which are not being addressed elsewhere. Under the National Agricultural Research Project (NARP), there was emphasis to take up need-based research through improved feedback mechanism from farmers to the researchers. But the mechanism was not effective in the absence of a formal unit to carry out research evaluation and priority-setting work. The methodology of Decentralised Agricultural Research Priority setting (DARPS) developed for the National Agricultural Technology Project may overcome this problem (Ramasamy et a/., 1994, Chapter 4 in this volume). The model has built-in mechanism to involve representatives of agro-industry, input dealers and farmers' organisations.

5. Training on Research Prioritisation Methods

Integration of research priority setting with research management and planning process is new to Indian NARS, and therefore, research managers and researchers need to be sensitised about benefits of research prioritisation. This must be followed up by hands-on training on research priority-setting methods.

Agricultural economists have the major responsibility of developing simple and effective priority-setting framework, organising training programmes and publishing materials which researchers and policy makers can understand and follow. National Agricultural Academy Research Management (NAARM), National Centre for Agricultural Economics and Policy Research (NCAP) and few SAUs may organise national level training for research managers and senior researchers. If necessary, institutions like International Service for National Agricultural Research (ISNAR), International Food Policy Research Institute (IFPRI), and Australian Centre for International Agricultural Research (ACIAR) may be involved in developing the methodology and organising training programmes.

6. Information System

Development of adequate database is critical for any decision support system. At the national-level, the ICAR may build up information on centre-wise research programmes, research funding, number of scientists (by field of specialisation), research infrastructure, researchable issues, agricultural production constraints, yield losses, farming systems, achievements in different research areas, etc. The database may also include detailed data on production, consumption, price elasticities, spillover effects of research and estimates of the potential impacts of research. Potential and observed project level impacts may also be included in these databases. The information may be categorised into sub-sections of crops, livestock, forestry, fishery, horticulture, etc. A systematic and consistent approach should be used for the collection, collation and presentation of information relating to the resources being allocated across research areas and states from the governments and other sources.

Analogously, the SARCC and SAUs must link their information systems to the national systems (NARCC/ICAR), so that research priority setting units are networked and linked for drawing information on all aspects relating to priority setting. The ICAR under a special grant must fund the creation of agricultural information network relating to priority setting. Similarly, the key research findings of individual research centres should also be made available to other researchers through the networking.

The outputs of CIS and remote sensing could be important inputs in priority setting, as they mirror the agro-climatic and production activities of a given region or sub-region. The superimposition of socio-economic information over agro-climatic information can help identify production typologies which can be used for priority setting. This could be responsibility of priority setting unit at the RRS.

User-friendly computer software may be developed for the impact analysis, priority setting, etc., and these should be available to all agricultural research institutions.

The ACIAR has developed an information system on research evaluation to support decision-making process. A similar information system may be developed in India for providing effective feedback about research impact and adjustment required in research planning (Davis and Lubulwa, 1994).

7. Conclusions

Agricultural research resources are allocated by policy makers and research managers in a subjective and ad-hoc manner. There is overlapping of research activities between ICAR and SAUs. In the context of growing shortage of research resources and accountability in the use of public funds, it is critical to rationalise research activities. The critical issues which need consideration are: "

1. The research partnership must be evolved among all research-organisations to foster complementarities and clarity in sharing responsibility of overlapping activities. There must be a basic research, pre-technology research, applied research and adaptive research so that overall efficiency of the system can be enhanced.
2. Evaluation of research and impact assessment is critical to guide and allocate scarce resources in a most efficient manner. The integration of research evaluation efforts through series of workshops must be strengthened. The NARS must be more enthusiastic in this kind of cooperative activities with the International Agricultural Research Centres (lARCs).
3. Consequent to economic liberalisation, private research investment is increasing in agriculture. There is a definite need for closer interaction between public and private research institutions.
4. Availability of classified research expenditure by sector, commodity, region, problem area, etc. is central to strengthening of research evaluation efforts. Premier institution such as the ICAR may take up responsibility in organising and publishing the data series on agricultural research.
5. National, state, organisational level research evaluation and priority-setting teams must be constituted to develop and prioritise research agenda.
6. There must be a continuous effort to improve the research evaluation methodologies. Some of the methodological issues which require attention are: (i) accounting for research spillover effects in a country like India where each state pursues agricultural research, besides lARCs, (ii) incorporation of interaction between research, extension and education in the evaluation framework, and (iii) allocation of agricultural research resources between maintenance research and technology development.
7. There is a need for training of agricultural economists in recent developments in the methodology of agricultural research evaluation.

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10 Synthesis and Institutionalisation Approach[1]

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This chapter synthesises main issues relating to the methods and institutionalisation approach of PME in Indian NARS. Since the institutionalisation is a system-wide activity to bring desirable functional changes, inputs from various groups, viz. agro-biological scientists, social scientists, management experts and research managers were sought and the emerging issues were examined in a wider perspective. Past experiences of Indian NARS as well as experiences of the PCAARD and ICRISAT were of immense help in evolving consensus and dealing with the operational problems. This chapter synthesises the main issues and presents major recommendations of the workshop.

1. Need for the Sensitisation

Whole efforts of PME institutionalisation aim to create a decision support system to strengthen research management process. Improved PME should be seen as a management tool and not a process to gain control over research and stifle scientific freedom and creativity. A system-wide realisation and appreciation of this improved management process is sine qua non for its successful institutionalisation. It would be desirable if the process is initiated with sensitisation of research managers and scientists.

Recommendation: Organise workshop and appreciation courses to sensitise top-level research manager and scientists

This should be followed by clear identification of hierarchical levels at which the capacity would be institutionalised. In Indian NARS, the capacity can be institutionalised at national (macro), eco-regional and institute (micro) levels. National and institute level PME efforts can easily be integrated with the management process, as these are consistent with existing institutional and administrative structure. However, eco-region level efforts need careful thinking. Under the NATP, eco-regions are well defined and therefore PME capacity can easily be institutionalised. But integration of PME under NATP with rest of the programmes would be a challenging task.

2. Methodological Issues Research Prioritisation

From analytical point of view, there are two main issues. First we briefly describe the choice criteria relevant for priority setting and research resource allocation and then the analytical methods are indicated.

Choice of criteria

Choice of research strategy is compounded by multiple criteria of evaluation. These are derived form 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.

Agro-biological scientists often emphasise specific research issues like food security, conservation of natural resources, productivity of rainfed agriculture, etc. for research prioritisation. All these concerns are important but these have to be translated into broad research evaluation criteria consistent with national goals. This is particularly important for macro-level (national) research priority setting. In the present context, the following criteria could be more appropriate for research prioritisation.

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

Analytical methods

Methods reported for agricultural research priority setting can be grouped into five categories: (i) scoring approach, (ii) benefit-cost analysis, (iii) programming models, (iv) simulation models, and (v) econometric models. 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 method (For details, see Alston et al. (1995), Jha et al. (1995), and Norton and Davis (1981).). However, economic surplus model can be used for macro-level priority setting (Davis et al., 1987) as seen from the ICRISAT's experience (Part II). On the other hand, the PCAARD and CGIAR experiences suggest use of a simple method for novice practitioners (Chapter 5, and TAG, 1992). For micro-level priority setting, simple, less data intensive method can be applied. However, micro-level priority-setting exercise should be decentralised and participatory involving all stakeholders (Chapters 2 and 4, and Evenson et al., 1996). Therefore, choice of analytical method is governed by availability of analytical capability, data and level of priority setting (national, programme or project) under consideration.

Second limitation of analytical methods developed so far, is their inability to prioritise basic research and other information generating research like social science research. Under the circumstances it would be desirable if deliberate scope is made for basic and social science research in resource allocation.

Recommendation:

- Research prioritisation approach should be participatory involving stakeholders.
- Linkages and trade-offs among research prioritisation criteria should be made explicit.
- Priority-setting method should be simple, transparent and allow timely flow of results.

Information needs

The analysis requires considerable amount of information and data, covering both scientific (technical) and socio-economic variables. These data should pertain to the level (national, region, institute) at which the exercise is intended. Therefore, for an objective research prioritisation, development of information system is essential. Socio-economic data can be compiled easily, but collection of reliable scientific information like R&D lag, probability of research success, expected adoption level, etc. is difficult. Historical evidence (on ex post estimates) can help obtain realistic ex ante estimates of these technology-related parameters (Chapters 2 and 3). This calls for linking of priority-setting exercise with ex post impact assessment work.

Recommendation:

- Strengthen capacity in ex ante research evaluation and priority-setting methods by organising training programmes.
- Develop and update database on socio-economic, technology-related and research impact variables and current allocation of research resources.

Monitoring and Evaluation

An attempt was made under the National Agricultural Research Project (NARP) to develop a system of monitoring research at the project and site level. In the ICAR system, a project information type system was introduced at the institute level. These have generally become defunct. Neither the scientists nor the management consider it important or useful.

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 (Chapter 6). The second reason is perhaps complexity of the format. The questionnaire is too cumbersome, it tries to cover a lot of information.

Research monitoring mechanism should emphasise explicit identification of targeted milestones and activities. These activities should be monitored using quantitative as well as qualitative indicators of inputs and outputs. It is important that these monitoring indicators are simple, objective and verifiable (Chapter 2). Perhaps a logframe kind of monitoring system will be more appropriate for monitoring research projects. Similar indicators can also be developed and applied for monitoring research at the institute and system levels. There should be 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 up seriously.

Recommendation:

- Revise, test and computerise RPF format, and provide guidelines 6n its integration into performance evaluation, ex ante evaluation and research funding decisions.
- Develop simple MIS with key variables and indicators to be implemented for NATP funded projects based on improved RPFs.

Impact Assessment

Ex post evaluation of research impact against well defined criteria, is an integral part of PME process. Currently, impact assessment efforts in the NARS are scanty and confined to only few successful technologies. Institutionalisation of the capacity will help evaluation of research achievements against targets and shortfalls, if any. It would also provide feedback to research planning by looking at the extent and causes of shortfalls and failures. The ICRISAT experience has shown that research impact assessment validates results of priority-setting exercise, improves technology design and accelerates rate of technology adoption (Chapters 3 and 7). At the same time, impact assessment analysis demonstrates research benefits useful to justify enhanced research funding. In order to add credibility to impact assessment work, it is extremely important that the analysis is carried out in an impartial manner (Chapter 2).

Recommendation:

- Organise in-depth training course on methods for ex post research evaluation and impact assessment.
- Develop a network of PME practitioners.
- Develop specific courses for incorporation into orientation courses and SAU curricula.

3. Institutionalising the Capacity

Currently, the capacity at various levels (national, regional and institute) is inadequate to address information and analytical needs of systematic work on PME. An attempt was made under NARP to create some capacity at Directorates of Research in various SAUs, but its focus was on monitoring and not prioritisation. The mechanism lacked seriousness and the process became ritualistic (Chapter 9.). Now that there is a consensus on the new paradigm, these deficiencies must be addressed. The purpose of PME institutionalisation is to create this capacity and integrate it with management units at each level in the research hierarchy.

Three issues are crucial. First, there must be a realisation at the decision-making level in each institution that (a) PME is important, (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, institutionalisation of improved PME should be initiated on following principles:

- Improved PME process should be simple, objective and transparent. Use of sophisticated analytical tools should not weaken the institutionalisation process.
- The process should be owned by the system. It should be participatory and long-term process with adequate in-house capacity.
- Necessary changes (organisational, functional and methodological) should be made to implement PME activities.

Central to the institutionalisation process is the integration of PME methods with the processes and consistency of approach across institutional hierarchies and regions (Chapter 8). Also, PME should be well integrated with financial, incentive and reward and personnel management systems. Links with financial system is essential to maintain timely flow of funds for successful implementation of research programmes. Any delay in availability of funds may jeopardise the implementation and monitoring process. On the other hand, successful planning warrants matching of scientific needs (arising from prioritised research portfolio) with availability of resources, and deficiency, if any, should be addressed through redeployment or training of scientists. Similarly, linking monitoring with career advancement scheme will make monitoring exercise serious and meaningful.

Recommendation:

- Policy advisory group in ICAR should meet regularly and be proactive.
- Where appropriate, improve design and implementation of existing PME mechanism.
- Integrate PME with research management process.
- Constitute a working group at the ICAR level to frame guidelines on research priority-setting approach and methods at institute and project-levels.
- Organise courses for hands-on training in PME methods, and develop guidelines for PME as part of project cycle.
- Constitute a multidisciplinary PME unit (preferably headed by economist) at the ICAR, SAD and institute-level.
- Pilot implement improved PME at 5-10 programmes (institutes/ SAUs) of diverse structure/mandates that are closely involved in the NATP.
- Reform administrative procedures including financial system (project-based funding) and personnel performance evaluation.

4. Summing Up

Improved PME mechanisms aim to rationalise allocation of resources, strengthen linkages between policy makers, research managers, scientists and clients, and improve overall efficiency of the system. It involves institutionalisation of a structured decision support system in the NARS. Past attempts in this direction were unsuccessful as they lacked institutional perspective. In-house capacity, commitment of resources and clear understanding of responsibility (who should do what) are indispensable. A simple approach of PME institutionalisation is outlined here. The proposed approach is consistent with structural and functional realities of Indian NARS, and would promote objectivity, transparency, decentralisation and accountability in the system. Its implementation should start with the NATP programmes and gradually diffuse in the entire system.

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[1] This chapter draws heavily on the discussion and recommendations of the workshop.