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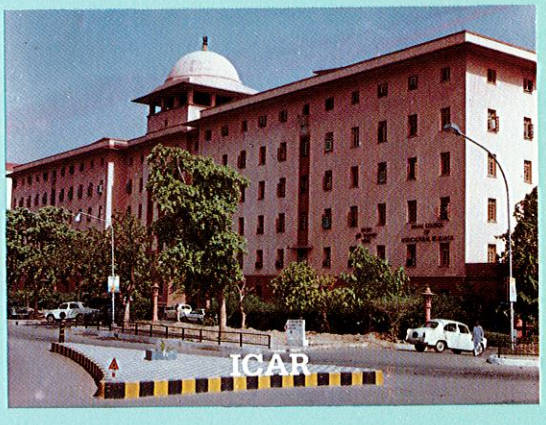
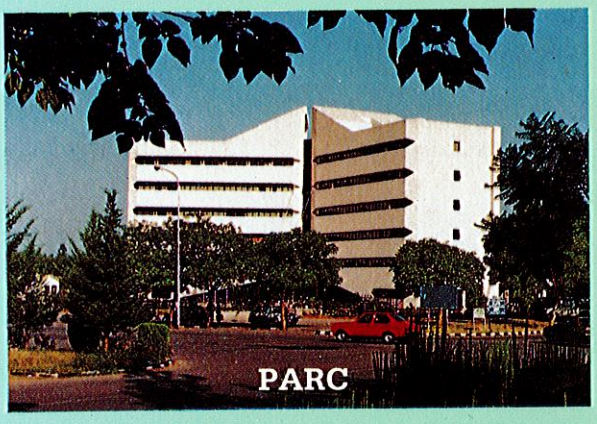
- ORGANIZATION AND MANAGEMENT

by

H.K. Jain





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FAO Regional Office for Asia & the Pacific
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CONTENTS

FOREWORD

Research and technology are the cornerstones of sustainable agriculture and rural development. Having recognized this, the Asia-Pacific countries have been establishing or strengthening their national agricultural research systems (NARS). But there are great variations in the organizational pattern and effectiveness of the NARS, thus presenting an opportunity for sharing the successful experiences. Further, based on the premise that the problems faced by most of the countries in their agricultural production and development are fairly common, it is natural for the countries in the Region to establish strong and viable research infrastructure and systems and cross-fertilise their experiences.

In the fast changing world agricultural scenario, National Agricultural Research Systems (NARS) in developing countries are confronted invariably with major issues such as: conservation of biodiversity, improved food security especially in the Low Income Food Deficit Countries (LIFDC), increased Household Nutritional Security, Sustainable Agriculture and Rural Development (SARD), Post-GATT agreement and globalization of agriculture, and above all the Agricultural Human Resources Development (AHRD). Many developing nations in the Asia-Pacific Region are addressing these issues in all earnest. Strategies and national policies are also being put into operation in order to have effective remedial measures before it is too late.

In the process, it is becoming evident that no individual NARS has the capability to deal with most of the new emerging challenges independently. Even vision of NARS towards well-established centres is changing and issues such as partnership role and devolution are being pursued vigorously. Also it is being convincingly felt that through Technical Co-operation among Developing Countries (TCDC), NARS could build their capabilities more effectively for technology generation, assessment and transfer. Unfortunately, many NARS in the different regions have not been able to yet devise suitable mechanisms/networks through which they could derive benefits from the strengths of one another. Even, information concerning strengths and weaknesses of different NARS in the region is not available at one place.

In view of the above, this publication of APAARI relating to agricultural research systems in South Asia by Dr. H.K. Jain is a timely step in the desired direction. I congratulate Dr. R.S. Paroda, Executive Secretary, APAARI for his initiative and vision to bring out a number of such useful publications. I hope this publication would serve a useful purpose to all those concerned with research and development of agriculture in the region.

A.Z.M. Obaidullah Khan
Assistant Director General and
FAO Regional Representative for
Asia and the Pacific

I. SUMMARY

The South Asian countries have taken important policy decisions in the past 25 years to reorganise and strengthen their agricultural research management systems. An important outcome of these decisions has been the emergence of autonomous Research Councils with major responsibility for research policy, planning and coordination. The more powerful of these Councils also manage a large network of federal research institutes and stations and provide funding and other support to the regional institutions in the states, specially in the organisation of a large number of nationally coordinated programmes. This paper discusses the organisation and structure of the newly created research councils in the different countries of South Asia, highlighting their differences within the framework of their common approach to help modernise agriculture with the development of a new kind of production technology. The paper describes the large investments that have been made in the countries of South Asia in creating an expanded research infrastructure and in training scientists, whose number in several of these countries exceeds that in research systems in other parts of the developing world.

The impact which these reorganised research systems have been able to make on agricultural production in a relatively short period of time by generating improved technologies has been documented with selected examples from the different countries. It has been concluded that the new agricultural research systems have been highly successful in organising major programmes of applied and adaptive research and in contributing to the widely acclaimed green revolution in these countries. At the same time, it should be stressed these systems have not been very efficient in the use of their resources, specially their vast resources of highly trained scientific manpower. An analysis of the different research and management functions which a research system is expected to perform has been made in this context. It becomes clear from this analysis that the performance of several of the councils in such important functions as planning and priority setting, programme formulation and monitoring, and management of personnel requires a great deal of improvement.

Finally, the paper discusses the future direction of the agricultural research management systems in the countries of South Asia. The main finding from this part is that the research councils of South Asia will have to see a major transformation in order to maintain their effectiveness in a changing agriculture and a new policy environment. The need will be for greater decentralisation with the councils concentrating mainly on research policy and planning. A shift in research policy will be necessary taking into consideration the need to develop a more productive technology for the dry and marginal lands which have been neglected in the past, the rise of biotechnology which offers new opportunities to increase agricultural production and the economic reforms now underway in many of these countries leading to the emergence of a strong private sector.

II. THE EARLY BEGINNINGS

Agricultural research has a long history in the South Asian countries going back to the early years of the century. Thus, one of the first centres of agricultural education and research in the Indian sub-continent was established at Lyallpur (now in Pakistan). Similarly, the Indian Agricultural Research Institute was set up at Pusa in the state of Bihar in Eastern India in 1905 from where it was later transferred to New Delhi in the 1930s. The most common form of organisation of agricultural research in those early years was that of research institutes and stations functioning under the Department of Agriculture. In the administrative hierarchy they were treated as subordinate offices of the Ministry of Agriculture and they functioned within the limits of the civil service rules and bureaucratic procedures which applied to all government offices and personnel.

The research service during this period had a limited mandate providing support for a subsistence kind of agriculture. Even so, it should be recognised that some very valuable work was done, specially in studying the country's natural resources of land, soils and water and their potential for supporting different crops and in describing the pests and pathogens which affected plant and animal production. A large number of improved varieties were evolved within the limits of modest use of modern farm inputs like chemical fertilisers. Some of these varieites have survived to this day.

III. STRENGTHENING AND REORGANISATION OF AGRICULTURAL RESEARCH

While traditional systems of farming associated with low crop yields have been practised in the South Asian countries for more than 5000 years, major policy decisions have been taken in the past 25 years to initiate the process of modernisation of agriculture and to strengthen and reorganise agricultural research for this purpose. Four basic considerations account for the new agricultural research policy which began to be developed in several of these countries in the 1960s and 1970s.

1. Food shortages

A number of South Asian countries in the 1960s started to face serious food shortages resulting from mounting population pressures. The human populations in these countries began to multiply rapidly with the advent of life saving drugs in the second half of the century. Secondly, the governments in the newly independent South Asian countries were called upon to improve the nutritional standards of their people and it was clear that the country's political, social and economic stability depended on achieving food self-sufficiency. Few of these countries had the economic resources to be able to import foodgrains. It was recognised at this point that a new kind of technology would be needed to bring about a major advance in agricultural production and the existing research infrastructure was quite inadequate for this purpose.

A series of reviews of research systems carried out with assistance from the Rockefeller and Ford Foundations and with other donor organisations made it clear that the bureaucratic structure of a typical government department was not very suitable for agricultural research, which needed a different kind of management culture and greater autonomy and flexibility in taking decisions.

The need for greater scientific input into national planning and policy making for agricultural development was also recognised. Traditionally such planning had been the prerogative of the civil service and the results had not been very happy. It was now felt that agricultural scientists should provide greater input in the formulation of plans and they should be consulted.

2. International collaboration

The International Agricultural Research Centres like CIMMYT and IRRI were beginning to emerge as important actors in the field of agricultural research in the 1960s and it became clear that if a developing country was to take advantage of the technologies developed by these centres, it must have a significant research capacity of its own for adaptive and applied research. Also, the South Asian countries were very fortunate in having political leaders who personally took the initiative for initiating the complex legislative and administrative actions required to transform the traditional research systems.

IV. THE REORGANISED AGRICULTURAL RESEARCH INSTITUTIONS

Before we can understand the important changes which have been made in the organisation of agricultural research in the South Asian countries during the past 25 years, it is important that we focus on the kind of institutions which are involved in such research. The agricultural research management system in a country in a broad sense consists of all those institutions which carry out research in the different fields of agricultural sciences. These institutions are often very diversely distributed in the various ministries of the government, parastatal bodies, faculties of agriculture and other science faculties in the universities, and those in the private sector having close links with the agri-business. A major source of strength of agricultural research in the developed countries is that they have strong research groups of this kind in all these different institutions and often they work with close interactions.

In the case of many of the developing countries on the other hand, the growth of the agricultural research management systems is not so balanced, as most of the research institutions are mainly in the public sector. Indeed, it is possible to argue that the core of the agricultural research systems in the countries of South Asia consists mostly of organisations and institutions created by the governments to provide technological support for their programmes of agricultural and economic development. The governments in the South Asian countries believe that in the interest of the farmers -their largest political constituency and contributors of a large part of the Gross Domestic Products of the country - science and technology should be harnessed as an important instrument of social and economic advance.

Autonomous Research Councils

The reorganisation of agricultural research which took place in the 1960 and 1970 is related mostly to these public sector institutions. Perhaps the most basic decision has been the creation of an agricultural research council as an apex body with major responsibility in the formulation of the country's agricultural research policy and for research planning and coordination. The Agricultural Research Council model which has evolved during the past 25 years helps to define more than any other institution the organisation and management of agricultural research in the South Asian countries. It should be recognised at the same time that this form of organisation of agricultural research continue to evolve and today's councils may see considerable change in the years to come. Also, as was to be expected, the different South Asian countries have experimented with the Research Council model in different ways, adapting it to their specific needs and socio-economic and political conditions. This has been a healthy trend which should be welcomed. No one has suggested that a single organisational paradigm is best for every country.

In order to understand the evolution of research councils and the institutions associated with them, it would perhaps be best if we define their general structure a little more clearly. The Agricultural Research Councils of the South Asian countries and their associated institutions are best seen in the form of a number of different components. It is the relationship of these different components which characterises the Councils in the different countries. As regards the Council itself as the apex body, it generally has a strong secretariat consisting of an executive head (Director General or equivalent) and supporting senior scientists, all of them with considerable experience in research management. There is also a strong group of administrative staff. The Director General of the Council and his/her deputies form the senior management team, and depending on the degree of decentralisation in the system, they often exercise considerable administrative powers. They also have major responsibility for strategic planning and for monitoring and evaluation of research.

The second important component of the research systems is a Governing Body or Management Board or an Advisory Council, generally made up of senior policy makers and administrators in the Ministry of Agriculture and other related ministries, senior extension officials, representatives of farmers, and members of the academic and political constituency of research. It is this Body which advises the executive head of the Council,generally an outstanding scientist, and other senior staff on the research and management policy. Because the senior officials of the Ministry of Agriculture and the Extension Service as well as farmers' groups are fully represented on it, this advisory body serves a particularly important role in making sure that research is closely tied to the development needs of the country and to the solution of farmers practical problems. The composition and functioning of this body, therefore, become particularly important. In the more successful research systems around the world, this body meets regularly and takes its responsibility seriously. Many of its members are influential people with direct access to the Minister of Agriculture and to the political and policy making level in the government and they therefore, serve a very important function in linking research with development and in generating public support for the system.

The third institutional component of the system is the research station network where the policies and priorities determined in the Council are translated into relevant research progammes and technologies generated. The fourth institutional entity which is a strong component of the research system in the larger South Asian countries takes the form of nationally coordinated research programmes, which help to integrate the research activities of the different experiment stations into an integrated framework, cutting across different disciplines and institutions of the federal and state (provincial) governments.

The South Asian countries,in general, are so large and agro-ecologically so differentiated that they must necessarily have a very large component of regional research. Indeed, it is possible to speak in some of these countries of a federal research system and of a state or provincial research system. Some of these latter systems are as large as the national research systems in many of the other developing countries of the world. A particularly important role of the Research Council is to promote the growth of the regional research systems and to coordinate the activities of the federal and state institutions in such a way that a high degree of synergy is achieved in the work carried out in the different institutions. The nationally coordinated programmes provide an important mechanism to achieve this objective.

V. AGRICULTURAL RESEARCH SYSTEMS OF DIFFERENT COUNTRIES

With this background of recent policy decisions, it is possible to draw attention briefly to some of the important features of the agricultural research management systems and the research councils associated with them in the different South Asian countries. The systems have been described in great detail in a number of recent publications specially in the reviews carried out by ISNAR, FAO and other international organisations. The present paper focuses on those features of the agricultural research management systems in the South Asian countries which are of importance in the context of their future evolution and which should help to analyse their strong and weak points. Also, it should be useful at this stage to describe briefly the contributions which these reorganised research systems have been able to make with in a short period of their establishment.

We may begin with a consideration of the organisation and structure of the institutions which have emerged in the different countries, the investments which have been made during the past 25 years, the scientific resources of these institutions and, their mechanisms for inter-institutional coordination specially in the larger South Asian countries where strong programmes of national and regional research have been organised. We may begin with the larger of these countries.

1. India

The agricultural research management system of India has been described as one of the largest of its kind in the world. The Government of India provides about 60 percent of all research funds, the state governments about 20 percent, private companies 12 percent and foreign agencies provide the rest. Public agricultural research expenditure has gone through three phases - a fairly rapid growth in the early 1960s followed by an accelerated growth in the 1970s with a slowing down in the 1980s.

Two far reaching policy decisions with major implications for the structure of the system deserve particular attention. First, the Indian Council of Agricultural Research (ICAR), reorganised in 1966 as the apex research organisation in the country, has been given enormous powers as a semi-autonomous body not only to plan and coordinate research nationally but also to be the main funding and executing agency for research. ISNAR publications* have described ICAR as a "managing" kind of council, which are the strongest of such institutions in the national systems performing a variety of functions including determination of research policy and priorities, linking them with government's development objectives, and establishing and managing a large network of research institutes and centres for carrying out research, and last but not the least, coordinating research in the federal and state institutions. Thus, councils of this kind are responsible for the development of research infrastructure and scientific manpower and for evolving suitable administrative and personnel policies. The network of experiment stations which ICAR manages directly in different parts of the country consists of 49 Central Research Institutes on different commodities and natural resources, 30 National Research Centres and 77 All-India Coordinated Research Programmes and 9 Project Directorates. The largest of these institutions, the Indian Agricultural Research Institute at New Delhi has more than 700 scientists. These diverse institutions cover agricultural research in its wide sense including crops, animal husbandry, fisheries, agroforestry, soil science and other related sciences.

The other equally important development has been the setting up of 27 State Agricultural Universities on the pattern of Land Grant Colleges of Agriculture in the United States, which have taken over all the research functions from the Department of Agriculture in the states. The State Agricultural Universities are the main regional institutions responsible for providing technological support for agriculture in the respective states. They receive their funding support both from the state governments and the Indian Council of Agricultural Research. The ICAR performs for the State Agricultural Universities the same monitoring role as the University Grants Commission of the Federal government does for the traditional universities. A large part of development budget of the State Agricultural Universities is provided by the ICAR. Also, the components of the All-India Coordinated Research Programmes in these universities which are a powerful instrument for linking the research institutes of ICAR with the State Agricultural Universities are supported by the ICAR.

The Agricultural Universities have a multi-campus structure in order to develop location specific technologies, they also have a network of zonal and regional research stations. A World Bank funded Project in recents years has helped to establish 120 Zonal Stations in the State Agricultural Universities covering the different agro-climatic zones and areas of different levels of socio- economic development. The Zonal Station in an agroclimatic region coordinates and monitors the work of all the other university stations in the region.

The primary responsibility for extension work is that of the State Departments of Agriculture with technical back up from the State Agricultural Universities which are responsible for first line

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* *Organisation and structure in National Agricultural Research Systems, ISNAR Working Paper No. 21, H.K. Jain, 1989.*

extension, that is, they communicate their technologies in a highly structured and institutionalised manner to the staff of the Government Departments of Extension. Thus, a State Agricultural University has a trinity of functions - research, teaching and extension all of which are fully integrated. The universities have a separate directorate of extension for developing close interactions with the farmers. The ICAR institutes organise large programmes of on-farm research as part of their process of technology verification and to remain in close contact with the farmers to maintain the relevance of their research work.

How does the Director General of the Indian Council of Agricultural Research relate to the Ministry of Agriculture and to the Government in general? The Government of India was very concerned as it reorganised the research system in the 1960s to make sure that an autonomous research council did not run away with its own research agenda and that it remained fully commited to the generation of technologies in support of the development needs of the country and was responsive to the practical problems of farmers. An institutional mechanism was devised for this purpose in the 1970s by making the Director-General of the ICAR as the permanent secretary of a newly created Department of Agricultural Research and Education in the Ministry of Agriculture - a small department but nevertheless one which structurally was an integral part of the goverment. As Secretary of this Department, the Director-General reports directly to the Minister of Agriculture bypassing the permanent Secretary of the Department of Agriculture. In this position the Director General has direct access to the policy making level of the Government and the Parliament. Furthermore, the Minister of Agriculture is the President of the Governing Body of ICAR which consists of representatives of farmers, senior officials of the Ministry of Agriculture and State Departments of Agriculture, members of Parliament, and eminent scientists from the universities. In this way an institutional mechanism has been created whereby the scientists of the Council function autonomously to manage their affairs free from the bureaucratic procedures of the government, but with full accountability to the government and with a clear understanding that they must respond to the development needs of the country and the farmers.

An important feature of the agricultural research system in India is that it generates its own scientific manpower. The 27 State Agricultural Universities have major programmes of post-graduate education turning out a large number of M.Sc. and Ph.D. graduates every year. The Indian Agricultural Research Institute in New Delhi was asked to set up a Post-Graduate School in 1958 which in the last 30 years has produced more than 4000 Ph.D. and M.Sc. graduates in different disciplines of agricultural science. This Institute and a number of other ICAR institutes have the status of a university for awarding their own degrees.

The All-India Coordinated Research Programmes described in detail in a number of publications including one from ISNAR, have been conceived as an instrument to mobilise the country's available scientific resources for focussing attention on major problems of agricultural production and finding effective technological solutions for them in the shortest possible time. These Projects have helped to generate inter-institutional and interdisciplinary interactions and ensure complementarity in the research programmes of different experiment stations, providing a mechanism for joint evaluation of new technologies evolved by their scientists and arrive at collective recommendations for their release to farmers. These coordinated programmes come nearest to the customer-contractor model of research organisation proposed in the 1980s by Lord Rothschild to the British Government for organising agricultural research with practical applications in view. Also, they bring together the federal and state research institutions into a closely integrated network of experiment stations.

2. Pakistan

The Government of Pakistan during the post-independence period has shown a strong commitment to agricultural research in its efforts to make new agricultural technology as an engine of agricultural and economic growth. Three provincial Agricultural Research Institutes and two Agricultural Universities were established in the early 1960s in order to provide a wider technology coverage for the country's agriculture. It was felt that the Agricultural Research Institute at Faislabad which had a long history of good work could not possibly meet the technology needs of all the different agroecological regions.

More fundamental changes in Pakistan's agricultural research organisation were made following a 1978 review of the research system conducted with the help of a World Bank/USAID/CIDA Mission. The mission's major recommendation was that the country needed a fully integrated research system including the federal and provincial institutions. The Government's response was the creation of Pakistan Agricultural Research Council (PARC) as the apex research organisation. PARC's mandate is to undertake, aid, promote and coordinate agricultural research, arrange the expeditious utilisation of research results; establish new research institutions as needed, promote development of scientific manpower; maintain a reference and research library; and to generate, acquire and disseminate information relating to agriculture.

It is clear that the policy makers in Pakistan wanted to create a strong research council and PARC has already taken a series of major steps in this direction. Thus, PARC has established a National Agricultural Research Centre at Islamabad, which is one of the most modern and best equipped agricultural research facilities in this part of the developing world. The Centre at Islamabad is also the Headquarters and funding agency for a large number of national commodity research programmes with cooperating units in the research institutions of different provinces and federal institutes. The Islamabad Centre houses seven major institutions covering following areas of research: crop sciences, horticulture, crop diseases, farm machinery, land resources, sustainable agriculture. In addition, PARC has set up five research instituons in different agroecological regions of the country responding to specific needs. These include the Arid Zone Research Institute, Quetta, Tropical Agricultural Research Institute, Karachi, National Tea Research Station, Spinbiari and the Himalaya Agricultural Research Institute, Gilgit.

It is clear that the Pakistan Agricultural Research Council has taken the first-steps to become a managing type of Council responsible not only for coordination and planning of research, but also far organising major research programmes with the creation of laboratories and field facilities which it funds and controls administratively. The Chairman of PARC is also Head of the Agricultural Research Division in the Ministry of Food, Agriculture and Cooperation with the rank of a permanent secretary so that he reports directly to the Minister. Thus, the Government recognising the important role of research has raised its status and given its senior managers direct access to the policy making level.

However, the agricultural research system in Pakistan is not fully integrated and PARC is not the main funding and executing agency for the country. Not all the federal research institutions have been brought under the administrative control of PARC. Some of the user ministries continue to manage their own research facilities. Thus, even in the Food and Agriculture Ministry, the Food and Agricultural Division maintains its own strong research infrastructure for cotton, forestry research, soil survey and research in marine fisheries. Also, the Science and Technology Division of the Ministry has strong research programmes in the field of drainage and reclamation of soils. Research on tobacco is carried out under the control of the Pakistan Tobacco Board and the Ministry of Water and Power is responsible for research on water quality and monitoring of soils.

In addition, the provinces continue to have an independent research infrastructure of their own which they fund largely from their own resources. The process of reorganisation of research in Pakistan has not made a fundamental change in the structure of research institutions in the provinces. Most agricultural research in provinces is carried out under the administrative control of the Department of Agriculture. In addition, there are three agricultural universities and a number of colleges of agriculture. The research institutes in the provinces are well equipped and staffed but for the most part they have maintained their heirachical structure.

There are indications that this may change. A recent innovation is the establishment of an independent Research Coordination Board with responsibility to improve the planning, coordination and funding of research in the province. The North Western Frontiers Province has gone a step further and has moved towards the Land Grant type of integration of education and research. All agricultural research stations in this province have been placed under the management of the Agricultural University which thus has responsibility both for teaching and technology generation.

In all, there are 46 large and small agricultural research institutes, three universities, a number of research laboratories and experiment stations, and there are 135 smaller research stations mostly under the major institutes in the different agroecological regions. It is important to recognise that there were relatively few experiment stations in Pakistan at the time of independence. The 46 research institutes cover crops and livestock, fisheries and forestry and the intention is to expand the research network so as to have a large number of single commodity institutes.

Over and above this large network of research institutions, Pakistan Atomic Energy Commission has a fairly large set up in the field of agricultural research where nuclear techniques are used for crop improvement and in the fields of soil science, soil biology, biochemistry of natural products, food science and entomology.

The coordination of research work of this large network of different institutions is the responsibility of the Pakistan Agricultural Research Council, which for this purpose has organised a number of fully integrated commodity improvement and development projects, involving groups of scientists from the different institutions in the provinces and the federal government.

3. Bangladesh

Although agricultural research in Bangladesh has a long history specially for traditional export crops like jute and tea, an important feature is that much of the current research infrastructure is newly created. The Government of Bangladesh following independence in 1971 took a bold policy decision to set up 10 major research institutes which today form the core of the national research system. The largest of these is the Bangladesh Agricultural Research Institute (BARI) close to Dhaka - a multi commodity crop improvement and production research centre, employing more than 600 scientists. The Bangladesh Rice Research Institute (BRRI) is one of the world's largest centres on rice research with a multidisciplinary focus on the improvement of the rice crop, the most important food crop of the country. The other major research institutes include the Bangladesh Jute Research Institute, Bangladesh Livestock Research Institute, Fisheries Research Institute, Bangladesh Forest Research Institute, Sugarcane Research and Training Institute, Bangladesh Tea Research Institute, the Soil Resources Development Institute and Bangladesh Institute of Nuclear Agriculture. Of these ten institutes, eight were established as autonomous institutions each headed by a Director-General who reports to the concerned ministry

including the Ministries of Agriculture; Fisheries and Livestock; Environment and Forest; and Commerce.

In addition to these institutes, agricultural research is carried out in Bangladesh in a number of universities, specially the Bangladesh Agricultural University and the recently set up Post-graduate Institute of Agricultural Education. Each of the ten institutes manages a network of regional stations and substations with the main objective of taking the research process closer to the farmers. This decentralisation of research facilities and personnel serves specific commodities as well as the different agroecological regions. The regional research station network is dispersed over more than 90 locations in the country, while most of the major institutes are located close to Dhaka.

It should be clear from the foregoing that the agricultural research institutions in Bangladesh are not closely integrated into a single organisation as in some of the other South Asian countries. The Government of Bangladesh, recognising this situation responded by creating the Bangladesh Agricultural Research Council (BARC) as an apex organisation. BARC has been given the responsibility for planning and monitoring research on crops, livestock, fisheries and in other fields conducted by the different institutes. Its role is to strengthen the national agricultural research capacity and it serves as the umbrella organisation under which the entire research effort is coordinated. BARC's own policies are laid down by its Governing Council which is headed by the Minister of Agriculture as its Chairman. The implementation of the Council's policies is the responsibility of the Executive Vice-Chairman of BARC and his advisors in the form of a member of member Directors responsible for different disciplines. BARC's specific role, thus, is strategic planning, priority setting, monitoring and evaluation and the overall coordination of agricultural research in the country. BARC has developed a mechanism for transfer of technology by linking closely through a committee with the governments's extension service, the NGOs, the agribusiness sector, and other development agencies. In addition, the different institutes and the Bangladesh Agricultural University have major programmes of farming systems research.

It should be stressed that BARC as a research council is quite different from other councils in the region in the sense that it has no role in the direct management or execution of research programmes. Indeed, it does not have any formal administrative or institutional links with the different research institutes, which report directly to their respective ministries. BARC itself reports to the Permanent Secretary of Agriculture and through him to the Minister of Agriculture. The research institutions in Bangladesh should be seen as part of the hierarchy of the different ministries of the government occupying the position of a subordinate office - not a very happy position for effective decision making.

4. Sri Lanka

The organisation and management of the agricultural research system in Sri Lanka has been greatly influenced by the fact that there are major stakeholders and interest groups who are able to articulate their demand for research support and contribute funds for the services received. The most important of these groups had its origin in the private sector in the form of tea planters. It is they who have been responsible together with the government in the establishment of strong export commodity research institutes. These single commodity institutes with a multi-disciplinary focus are generally well funded and managed and they are organised as autonomous bodies. They have their own Board of Governors, which advises the director and the senior staff. The funding comes in the form of a cess levied by the government on exports. The export commodity institutes in Sri lanka as in other developing countries tend to be in a class of their own, deriving strength from their close interaction with an enlightened

group of clients, who seek new technologies and are able to make large investments in modern farm inputs to adopt the recommendations made by the scientists.

The other major actor in the organisation of agricultural research is the Department of Agriculture with its Research Division. Research in the Department is organised mostly in the form of Regional Research Centres each of which has its own satellite stations covering the different agro-ecological regions. The main centre of the agricultural Research Institute at Gonnawar provides technical backstopping to these regional institutions. The different regional research centres have their mandate for different commodities including minor export crops, animal production and health, and also of course, the major food crops like rice. In addition, the Department of Agriculture has organised an Agrarian Research and Training Institute where a large group of social scientists work on problems relating to various fields of agricultural development.

In addition to these two main groups of research centres, a number of other ministries maintain relatively small research groups in the field of forestry and irrigation. The Ministry of Higher Education supports research in the faculty of agriculture in the universities. The system as a whole has about 500 scientists with half of them in the Research Division of the Department of Agriculture.

In more recent years, the Government of Sri Lanka has felt that the multiplicity of research institutions in the different Ministries has created problems in evolving a national research policy and in coordinating the work of different groups of scientists. Also, this kind of thin dispersal of scientific resources does not lend itself to their optimal utilisation. It is on the basis of considerations of this kind and following a joint review with ISNAR, that a Council of Agricultural Research Policy (CARP) was created in the late 1980s with the major objective of coordinating the work of different organisations. The Council has been asked to develop a national research plan and evolve common policy guidelines for all the ministries and agencies with a view to undertaking a review of the existing research projects. Also, the Council should advise the Government on the development of further infrastructural and resource requirements and initiate inter-institutional collaboration in research, helping to create in this way a more integrated research system. The Government recognising the important responsibilities assigned to the Council has given a high administrative position to its Director General equivalent to that of a Permanent Secretary. The Council also derives strength from the fact that the secretaries of all the concerned ministries sit on its Board.

The CARP in Sri Lanka is not a managing type of Council - its essential role is that of planning and coordination, but is closely linked to the policy making level in the Government, specially the powerful Finance Ministry.

5. Nepal

Historically, the research system in Nepal has been complex in its organisation consisting of a network of agricultural research stations in various agroecological regions operating through several Disciplinary Divisions and Commodity Development Programmes. Eight of these agricultural research stations and six farms had been established in the earlier years, largely in support of commodity development and as testing sites. In addition, there has been a major complex of technical Divisions in the Kathmandu valley where the senior scientists are located, not so much for carrying out researches of their own but more to advise the scientists of the regional stations and to perform other regulatory functions for the Ministry of Agriculture.

In the last 10 years the need for a major restructuring of the research system has been increasingly felt and following a series of initiatives, some firm decisions have been taken in the past 5 years for the creation of a new organisation. This organisation named as the Nepal Agricultural Research Council (NARC) has been created as an autonomous body charged with the responsibility of organising research for the development of agriculture. The new Council will be controlled by an Executive Board which has been given the responsibility of defining the research policy, determining national priorities, allocating resources and evaluating research results. The Board will also be responsible for coordinating with the different national agencies as stakeholders in research and its results and with the donor community.

In order to ensure that the Nepal Agricultural Research Council remains fully commited to its mandate of promoting agricultural development in the country, the Executive Board has the Minister of Agriculture as its Chairman, while the Secretary of the Ministry of Agriculture, Director General of the Department of Forests, and a Joint Secretary in the Ministry of Finance, will be among its members. Also, represented on the Board are the University, the agro-based industries, the farmers, and the agricultural scientists. The Executive Director of the Council will be the member Secretary of the Board with direct access to the Minister, and with staff support from five Technical Directors.

The first task of the new Council is the establishment of a number of national agricultural research institutes in different fields of agriculture. Two new institutes - a National Agricultural Research Institute and a National Animal Science Institute are already being developed. They will take over much of the existing research station infrastructure. In addition to the national institutes, regional agricultural research stations will be developed which will work in a multi-commodity, multi-disciplinary mode. In all, twenty agricultural research stations are proposed to be established, four of which are being designated as regional agricultural research stations.

While the Nepal Agricultural Research Council will function as the apex organisation in the country, it will collaborate with a number of other institutions which are already active in agricultural research. These include the Faculty of Agriculture of the Tribhuvan Agricultural University and the Institute of Forestry. The University has a large number of highly qualified agricultural scientists, whose services have not been utilised for development oriented research in the past. Nepal also has two regional stations being funded almost entirely by the British Government. They have been highly successful in carrying out farming systems research.

6. Bhutan

The research system in Bhutan is understandably a small one with only a handful of scientists. In the past, these scientists were dispersed over different Departments of the Ministry of Agriculture with little interaction between them, and between the scientists and the staff of the extension service. In the past three years following a comprehensive review supported by the Government of Switzerland and carried out in collaboration with ISNAR, major changes have been made, culminating in the creation of a new research organisation. The new organisation named as the Research Extension and Irrigation Division (REID) in the Department of Research, Technology Transfer and Training under the Ministry of Agriculture will bring together scientists from all the different Departments including Agriculture, Animal Husbandry and Forestry and will also integrate the Extension Service in it. REID is headed by a Director General and is organised into three sections - Research, Extension and Irrigation each under a Chief Scientific Officer. With the creation of this new Division, the process of rationalisation of the research station network is now in progress. It has been decided to reorganise the existing

stations into four research complexes and four research support centres. The four research complexes will be the homes of the new research programmes where researchers in crops, livestock and forestry can share common facilities, and can be backstopped by a common pool of technical and administrative support staff.

A particularly innovative feature of the new research organisation in Bhutan is that the research programmes will be organised not along disciplinary or commodity lines as is common in many countries, but along production systems. The scientists in Bhutan working with their counterparts from the visiting team from ISNAR identified three production systems based on land use patterns - dry and wet land plantations; pastoral forest based, and shifting cultivation. Each of these systems is so integrated in terms of crops, livestock and forest products both for production and for maintenance of natural resources that it was considered feasible to organise research around them rather than to compartmentalise it in different departments. The constraints of each of the production systems are proposed to be analysed and research teams will be constituted on a multi-disciplinary basis, taking these into consideration.

The recent experience of Bhutan shows that a small research system offers opportunities of innovations which may not be possible in some of the larger countries.

The structure and organisation of the large research systems in the South Asia as we saw can be quite complex. **Appendix 1** provides a simplified diagrammatic representation of some of these systems.

VI. INVESTMENTS IN AGRICULTURAL RESEARCH AND RETURNS

It is widely recognised that the investments which many developing countries have made in strengthening and reorganising their agricultural research systems during the past 25 years have paid rich dividends. The new agricultural technology generated during this period has probably made its greatest impact on the agriculture of the Asian countries, and among these, the larger South Asian countries like Bangladesh, Pakistan and India have been some of the major beneficiaries. Sri Lanka, and to a lesser extent Nepal, have also benefitted significantly from the new technology.

1. Contributory factors for impact

Three factors basically account for the large impact which the reorganised research systems have been able to make on agricultural production in these countries. First, the South Asian countries, in general, have had enormous resources of scientific manpower, thanks to a well established university system going back to the early years of the century. Some of the other regions of the developing world such as the sub-Saharan Africa have had to do with a much more limited scientific capacity in comparison, because relatively few local scientists had been trained to take up responsibility for research at the time of independence. Secondly, despite their considerable richness of natural resources, traditional agriculture in South Asian countries has been characterised by low yields with the result that a major input of new technology supported by modern farm inputs like chemical fertiliseres has boosted the yields quite dramatically in crops like wheat and rice. Thirdly, the governments in the South Asian countries have shown a strong commitment to research. They have been liberal in allocating vastly increased funds for agricultural research and they have made serious efforts to make sure that the research service remains closely linked with the development needs of country's agriculture and that the scientists do not pursue

their own academic agenda. This is not to say that funds have not been available for basic research but, in the short term, the main objective of the governments has been to harness research for solving farmers' problems and for increasing agricultural production in the shortest possible time. Even the concept of autonomy for the newly created research councils was conditional and the scientists were asked to work in close collaboration with agricultural administrators, extension personnel and farmers. A variety of institutional mechanisms to ensure accountability of this kind has been built in the research systems as we saw earlier.

2. Investments in research and scientific strength

We may begin with the increased investments in agriculture research which have been made in the past 25 years. For South Asia as a whole the expenditure on agricultural research increased nearly 6-fold during the period of 1959 to 1980. This can be seen from **Table 1** which shows the expenditure on agricultural research in 1980 value of the US dollar over the two periods for different sub regions of Asia.

With in South Asia all the countires have increased their research investments and number of scientists; this is brought out clearly from ISNAR Agricultural Research Indicator Series*, which summarises the research expenditure during the preriod from 1960 to 1986. The expenditure is given in 1980 US dollars, taking into consideration the purchasing power parity of the local currency in relation to the US dollar.

Table 1. Increase in Expenditure on Agricultural Research in Three Subregions of Asia During Three Period Since the 1960s

Expenditure (Constant 1980 US$ Thousands)			
	1959	**1970**	**1980**
South Asia	32,024	72,573	190,931
Southeast Asia	9,028	37,405	103,249
East Asia	141,169	521,971	734,649
Expenditure as % Value of Agricultural Product			
	1959	**1960**	**1980**
South Asia	0	0.19	0.43
Southeast Asia	0.1	0.28	0.52
East Asia	0.692	0.012	0.44

Source: Ann Judd et. al (1987): adapted from ISNAR Working Paper No. 32, Y.D.A. Senenayaka, 1990

Table 2 summarise this expenditure for the different countries along with the number of full time equivalent (fte) researchers. It should be explained that the expenditure here relates to the actual amounts spent rather than those appropriated by the governments' in their budgets which may have been higher. It is clear that in each of the South Asian countries there has been considerable build up of the research infrastructure compared to what existed in the early 1960s. This is reflected in the number of

* *ISNAR Agricultural Research Indicator Series, Philip G. Pardey and Johannes Roseboom, Cambridge Univ. Press, Cambridge, 1989.*

scientists added to the system over this period. The number here is derived using a defined methodology so that some of the staff members such as teachers in agricultural universities who spend only part of their time doing research are not treated as full time researchers. A formula has been devised which helps to convert their number into full time equivalent research personnel. Also, the vacant posts whose number may be quite large have not been included.

Table 2. Agricultural Research Expenditure and Personnel

Country	Expenditure (Million 1980 ppp dollars)		Researchers (fte's)	
	1961 - 1965	1981 - 1985	1961 - 1965	1981 - 1985
Bangladesh	21.8	68.4	296	927
China	271.4	933.7	6,966	32,224
India	116.1	450	2,939	8,389
Indonesia	40.7	141.1	415	1,349
Malaysia	14	110.8	151	811
Pakistan	13.5	74.3	893	2,972
Philippines	17.6	28.6	375	1,965
Sri Lanka	6.7	21.4	74	391
Nepal	3.2	10.7	96	401

Source: ISNAR, Agricultural Research Indicator Series, Cambridge University Press, P.G. Pardey and J.R. Roseboom, 1989

Table 3. Agricultural Research Indicators in Countires of South Asia

Country	Importance of Agriculture		Expenditure on Ag. Res. 1980-1985 Averages				Per Economically Active Ag. Pop. 1980-84 Average (1980 US$)	Per Hectare Ag. Land 1980 only (1980 US$)
	% AgGDP of GDP 1984	% Economically Active Ag. Pop. of Ec. Ac. Pop. 1988	Total US$ 1980 (million)	US$ per Scientist 1980 (000)	As a % of GDP	As a % of AgGDP		
Bangladesh	48.39	69.81	71.45	64	0.14	0.30	3.65	8.52
India	33.28	67.14	449.89	54	0.11	0.30	2.36	2.63
Nepal	61.75	91.97	11.12	26	0.13	0.21	1.87	4.93
Pakistan	24.68	50.64	48.53	16	0.05	0.19	3.34	2.40
Sri Lanka	24.42	52.02	21.03	69	0.1	0.38	7.03	9.08

Source: Adapted from ISNAR Working Paper No. 33. Y.D.A. Senanayake, 1990: based on P.G. Pardey and J.R. Roseboom

Finally, it should be interesting to see how the expenditure on agricultural research relates to the gross domestic product of the country; the agricultural gross domestic products; the agricultural populations and to some other parameters. This analysis is presented in **Table 3.** It will be seen that for all the countries of South Asian region, investment in agricultural research constitutes less than one half of one percent of the agricultural gross domestic products and nearly 0.1 percent of the total GDP. For each hectare of agricultural land, India and Pakistan spend much less on agricultural research compared to Sri Lanka and Bangladesh. For its economically active agricultural opulation, Sri Lanka spends almost twice as much on research as the other countries, with Nepal spending the smallest amount.

3. Rates of return analysis

Coming now to documentation of the impact of agricultural research following the policy decisions of the 1960s and 1970s, it should be stressed that few formal studies of the rates of return have been made. This is unfortunate because research managers need an analysis of this kind to persuade policy makers and politicians to make greater investments. The few studies which have been made will be reviewed here followed by a brief account of the impact on overall development of agriculture in the different countries of South Asia.

One of the first analyses of this kind for crop related research was carried out by Evenson for India. Evenson* reported that an increment to the state research capital stock of 1000 rupees is associated with a direct increase in the value of agricultural products of 6,600 rupees. An additional contribution of 1,300 rupees is forthcoming through interaction when extension activity is undertaken. Thus, the 7,900 rupees can be viewed as the level to which the generated income stream grows after the distributed lag period. Consequently, the 7,900 rupees income stream represents a 46 percent internal rate of return. A similar study for India has been reported by Kahlon* and his colleagues in which they measured returns to public investments in agricultural research. They found an investment of one rupee in agricultural research gave a return of 11.61 rupees with a lag of 5 years between research expenditure and returns. Assuming a 5 years lag period they arrived at an internal rate of return of 63.3 percent per annum, which is somewhat higher than that reported by Evenson.

In the case of Bangladesh, M.S.U. Chowdhury, the Executive Vice Chairman of BARC, has summarised results of similar studies for his country. According to him, conservative estimates suggest that the benefits from agricultural research during the 1970s were twice the total costs including long term investments of establishing and supporting research. In the case of rice specifically, recent studies carried out by Dey and Evenson (not yet published) have suggested that the return on investment on rice research in Bangladesh is about 143 percent which is obviously very high.

The only other country in South Asia from which results of an analysis of this kind could be gathered is Nepal. According to a paper presented at the Expert Group Meeting on Sensitizing Agricultural Research to Community Development Needs organised by the Economic and Social Commission for Asia and the Pacific in August 1993, it was reported that the rate of returns on investments in research on cereal grains ranged from 33 percent for maize to 66 percent for rice. A more recent study by CIMMYT on returns to wheat research in Nepal showed that from 1960 to 1990, the internal rate of return for public sector investments in wheat research was 75 to 84 percent. This high rate of return arose from successful introduction of improved germplasm of wheat from CIMMYT and from India.

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* *Robert E. Evenson; A.S. Kahlon et al (in Resource Allocation and Productivity in National and International Agricultural Research. 1977, University of Minnesota Press, Minneapolis, ed. T.M. Arndt, D.G. Dalrymple, V.W. Ruttan).*

VII. IMPACT ON OVERALL AGRICULTURAL DEVELOPMENT

That the new agricultural technology has had a major impact on agricultural development in all the countries of South Asia is well recognised though not so well documented. One question which is often asked is how far these positive developments can be attributed to research per se when it is known that many other policy decisions of the governments have contributed to agricultural development. There can be several answers to this question and the need obviously is to carry out a detailed analysis. In the absence of studies of this kind, we must look for other indicators. There are a number of them. Thus, the area under the newly developed high yielding varieties of wheat and rice and of several other crops has increased greatly in all the countries of South Asia. Almost the entire wheat area in Bangladesh, a new crop for that country, is planted with high yielding dwarf varieties carrying Norin10 genes. In Pakistan, and India, the high yielding varieties of rice have saturated very large areas, a significant part of it in non traditional rice lands. Most of the wheat crop in Pakistan and India is now planted with the new high yielding varieties. Farmers will not be taking to these varieties if they did not find them profitable.

Secondly, the use of modern farm inputs has seen a phenomenal increase in several countries of South Asia with the advent of the new technology. Thus, neither India nor Pakistan nor Bangladesh, used a significant amount of inorganic fertilisers at the time of independence. India today is the fourth largest producer and consumer of fertiliser nitrogen in the world. The use of chemical fertilisers has increased even more dramatically in Bangladesh and Pakistan. Both countries having large feed stocks of natural gas and have built a large indigenous capacity for the production of nitrogenous fertilisers.

The traditional crop varieties which were widely cultivated in these countries before the advent of new agricultural technology were not known be highly responsive to chemical fertilisers. The use of these fertilisers as well as the development of modern irrigation has grown with the widespread distribution and adoption of the seeds of high yielding varieties by the farmers. Finally, the point should be made that the countries of South Asia have developed very close collaborative relations with the International Agricultural Research Centres like CIMMYT and IRRI. It has been suggested that only those countries have been able to take advantage of the technologies developed by these international centres which have strong research programmes of their own in the area of adaptive and applied research.

In short, it is possible to conclude that while many different initiatives on the part of the governments such as the creation of an institutional framework of support services, production and distribution of modern farm inputs, supply of credit to farmers and assurance of support prices to them have helped to bring about a major transformation of agriculture in the South Asian countries in recent years, a key role in this process has been played by the new agricultural technology. It is doubtful that the governments will have invested in creating the new infrastructure of agricultural development in the absence of proven technologies for higher productivity, which could be demonstrated on farmers' fields. It has been often argued that agricultural development is not possible in the absence of major policy decisions by the governments. In this particular case the availability of a new technology acted as a catalyst in persuading the governments to take important policy decisions.

What has been the nature of agricultural transformation in the South Asian Countries? A few selected examples given below should help to illustrate this transformation.

Self-sufficiency in foodgrains

Perhaps the most important change has been with regard to the achievement of self-sufficiency in foodgrains. Both India and Pakistan became heavily dependent on import of foodgrains in the 1960s in the face of rapidly rising populations. The highest priority at the political level at this point of time was given to achievement of self-sufficiency in foodgrains. That self-sufficiency has been now largely achieved by both countries at the current levels of consumption and purchasing power. **Table 4** shows the production, area and yield of major foodgrains in India over different time periods. It will be seen that in addition to production the yield per hectare has nearly doubled in many cases.

Table 4. Area, Yield, and Production of Foodgrains in India, 1949/50 - 1983/84

Item/Period	Three-Year Average				
	Rice	Wheat	Coarse cereals	Pulses	All Food-grains
Cropped Area (m.hectares)					
1949/50-1951/52	30.50	9.70	38.30	18.90	97.30
1962/63-1964/65	36.10	13.50	44.20	24.10	117.80
1967/68-1969/70	37.00	15.90	46.90	22.00	121.80
1981/82-1983/84	39.90	23.50	41.70	23.40	128.50
Yield (Kilograms/hectares)					
1949/50-1951/52	763	688	464	501	587
1962/63-1964/65	1,014	812	557	471	708
1967/68-1969/70	1,060	1,160	577	518	790
1981/82-1983/84	1,332	1,784	746	517	1,076
Production (m.mt.tons)					
1949/50-1951/52	23.30	6.60	17.80	9.50	57.10
1962/63-1964/65	36.60	11.00	24.60	11.30	83.50
1967/68-1969/70	39.30	18.40	27.10	11.40	96.20
1981/82-1983/84	63.30	41.90	31.10	12.10	138.40

Source: International Food Policy Research Institute (IFPRI), Report No. 81, J.S. Sarma and Vasant P. Gandhi, 1990

Table 5 summarises the impact of crop production planning in Pakistan over a 5 year period from 1977-78 to 1982-83. The crops include not only major foodgrains but also some of the other important commodities like oilseeds, pulses, vegetables, spices and fruits. It is clear that while wheat, rice and maize, the three most important foodgrains of the country have all registered major increases in production over this short period, significant gains have also been made in the case of oilseeds, fruits and vegetables. An exception is provided by the pulse crops.

Table 5. Crop Production Planning and its Impact in Pakistan over a Five-Year Period (in million metric tons)

Crops	1977/78	1981/82	1982/83	% Change Col.4/col.2
Foodgrains	12.86	16.32	17.47	36.00
Rice	2.95	3.43	3.45	17.00
Wheat	8.37	11.30	12.41	48.00
Maize	0.82	0.30	1.01	23.00
Others	0.72	0.66	0.60	-7.00
Cash crops	30.66	37.33	33.35	9.00
Oilseeds	1.50	1.85	2.08	39.00
Pulses	0.81	0.49	0.69	-15.00
Vegetables & spices	1.21	2.72	2.98	36.00
Fruit	2.09	2.94	3.17	52.00

Based on crop Statistics of Pakistan, 1985, Government of Pakistan, Islamabad

Table 6. Foodgrain Balance Sheet in Bangladesh

Year	Population '000	Foodgrain Requirements '000 MT tons	Foodgrain Production 000'MT tons	Foodgrain Gap '000 MT Tons	Foodgrain Imports '000 MT tons
1980-81	87,120	14,433	13,242	1,192	1,679
1981-82	88,593	14,678	12,908	1,770	1,254
1982-83	90,091	14,926	13,539	1,387	1,870
1983-84	91,614	15,178	13,900	1,278	2,134
1984-85	93,164	15,435	14,223	1,212	2,575
1985-86	94,739	15,696	14,221	1,475	1,032
1986-87	96,341	15,961	14,538	1,374	1,796
1987-88	97,970	16,231	14,556	1,675	2,920
1988-89	99,626	16,505	14,648	1,858	2,138
1989-90	101,311	16,785	16,576	208	1,534
1990-91	103,024	17,068	16,672	396	1,577
1991-92	104,766	17,357	17,080	277	1,507

Source: Handbook of Agricultural Statistics, July1, 1993 Sector Monitoring Unit, Ministry of Agriculture, Government of Bangladesh

Note: (i) Production has been netted by 11.58 percent for seed, feed and losses.
(ii) Foodgrain requirement is estimated on the basis of 16 ounces per person per day.

In some ways the gains made in agricultural production in Bangladesh are even more impressive. Bangladesh until recently was considered to be a basket case. In the 1980s it became heavily dependent on donations of foodgrains, with a gap amounting to 1.192 million metric tons in 1980-81. In 1990 the country had increased its rice production so much that the gap was narrowed to 277,000 metric tons **(Table 6)**. The total production of rice in Bangladesh increased from 11.11 million metirc tons in 1974-75 to 18.25 million metric tons in 1991-92. The production of wheat during this period increased even more Bangladesh can look forward to food self-sufficiency at least in the near future.

In the case of Nepal, the situation is slightly different in the sense that the new technology has made its impact only in those parts of the country where management of soil fertility and water presents fewer problems. Thus, food production has seen a significant increase in the foothills but there has been a decline in other regions including the hills and the mountains. The greatest gain has been made in the production of wheat in the foothills. **Table 7** summarises the trend of foodgrain yields by different agroecological regions in the country. In Sri Lanka, perhaps the largest impact has been on rice production as shown in **Table 8**.

Table 7. Nepal Trend of Foodgrains Yield by Different Ecological Regions (Average Yields:Mt/ha)

Crops	Av. Yields, 1970/71			Av. Yields, 1980/81			Change (%) from 1970 to 1981		
	Mount.	Hills	Terai	Mount.	Hills	Terai	Mount.	Hills	Terai
Paddy	2.38	2.49	1.85	1.91	2.18	1.88	-19.80	-12.50	1.60
Maize	1.87	1.77	1.62	1.59	0.60	1.68	-15.00	-9.60	3.70
Wheat	1.06	1.12	0.78	1.03	1.22	1.30	-2.80	-13.70	66.40
Millets	1.19	1.17	0.90	0.99	1.01	0.94	-16.80	-13.70	4.40
Barley	1.06	0.98	0.70	0.91	0.87	0.88	-14.20	-11.20	15.80

Source: Agricultural Research Systems in the Asia-Pacific Region, Regional Office for Asia and the Pacific, FAO, Bangkok, 1986

Table 8. Production of Rice in Sri Lanka

Year	Area (000, ha)	Production (000, mt.ton)	Yield (kg/ha)
1979 - 1981	819	2,093	2,555
1989	690	2,063	2,990
1990	828	2,538	3,064
1991	860	2,397	2,787
1992	790	2,250	2,848

Source: Various Sources, including the FAO

VIII. MANAGEMENT OF AGRICULTURAL RESEARCH IN SOUTH ASIAN COUNTRIES

Based on the kind of impact presented above it is widely recognised that the reorganised agricultural research systems of the South Asian countries have been quite successful. The question which we should ask at this stage is whether they have also been efficient in the use of their scientific and other resources. The general impression is that the research systems in these countries have not been very efficient and that their success is limited to commodity improvement with very little to show in the management of their natural resources of land, soils and water. The success which they have achieved can be attributed largely to their vast resources of highly trained scientists and the favourable attitudes of their governments to support research.

The efficient organisation and management of agricultural research in a country must be evaluated in terms of a number of functions which the system is expected to perform. It is the effective discharge of these functions which determines the productivity of the system. For evaluating the performance of the research systems in the South Asian Countries and in determining their future direction, it it important that we consider some of these functions and then examine how well these have been performed. Broadly speaking these functions are of two kind - research functions and management functions as discussed below.

1. Research functions

A. Research priorities and resource allocation: Most research systems work under severe resource constraints and it is necessary that they have clearly defined priorities and programmes. The senior managers of the system should be able to inform the policy makers about the country's production potential in relation to its agro-ecological diversity, natural resources, its comparative advantage, and the opportunities which research offers to realise this potential. An important outcome of this kind of interaction with the policy makers is a carefully thought out plan and priorities resulting in resource allocation for research on different commodities and natural resources, with support from different disciplines and taking into considerations the needs of the different regions of the country. A number of formal methods are available to assist in this process of priority setting and resource allocations.

B. Programme formulation: The research priorities must be translated into relevant research programmes whose implementation would determine whether the country would be having the right kind of technology for increasing agricultural production. The process of programme formulation is a highly interactive one involving both a top down and bottom-up approach. Basically, the programmes must be formulated by the scientists at the experiment stations but they must receive clear messages about the national and regional priorities and about the problems to be solved.

C. Monitoring and evaluation: An in-built mechanism of mid-cours correction and improved planning of research programmes is necessary if the different projects on conclusions are to yield useful results. The senior managers must put in place a good system of monitoring and evaluation of research for this purpose.

D. Research coordination: Most agricultural research designed for generating new technologies calls for a multi-disciplinary approach. Further, large countries with a multiplicity of research institutions must coordinate their work in order to be cost effective. Ideally, a large country will have a limited number of national institutions which do the more advanced strategic and technology generating research and a chain of regional stations in different parts of the country, which would be mainly involved in

adaptive and applied research, working in close collaboration with the extension service and the farmers. The important requirement is to link these two types of institutions effectively and to coordinate their work.

E. Links with Extension: The research service in most countries is not equipped to reach the large number of farmers in different parts of directly for transfer of technology - that job really belongs to the extension service. The research system, however, has a major responsibility to develop institutional links with the extension service for a two way flow of information. This is often described as the first-line extension service. It calls for investment of resources on the part of research and a separate unit must be created for this purpose which brings together scientists from different disciplines and the extension personnel in a common forum for a discussion of the new technologies and farmers' problems in adopting them.

2. Governance functions

The governance functions relate to the administrative procedures and decision making processes in the working of the agricultural research systems. Scientific institutions are not expected to have too much of administration. Even so, no system can do without it. Budgets must be made and defended and strict financial discipline must be maintained specially when public funds are involved. Personnel policies should be so formulated that they motivate the scientists. Also, the experiment station network should be so organised and managed that it can be rationalised in terms of agro-ecology and best use of the limited funds. Finally, there is the question of centralisation. The degree and nature of the administrative control which the head of the system exercises over the field stations has become an important governance issue in recent years specially in the larger research systems.

With this background, we may now briefly review the future evolution of national agricultural research systems in the South Asian countries, pinpointing some of their strong and weak points.

3. Functions and performance evaluation

The most important function of a national research system is in the area of policy making and planning. Marie-Helene Collin* of ISNAR has given what is perhaps the best definition of agricultural research planning and policy making. According to her, research planning and policy making is the instrument through which the country translates its development objectives into research objectives, priorities and strategies with various time horizons. It allocates its resources to major programmes reflecting these objectives, priorities and strategies.

How well do the South Asian research systems perform these functions? As far as policy making is concerned, there are reasons to believe that they do a good job. Agricultural research systems in the South Asian countries are very closely linked with the Ministry of Agriculture and other development oriented departments of the government, including the Planning Commission. The policy making Boards of all the research councils in South Asian countries are dominated by stakeholders and clients of research, including senior agricultural administrators, officials of the extension department, representatives of farmers' organisations, among others. Also, the executivehead of the Council reports directly to the Minister of Agriculture in many cases and to the permanent secretary of the Agriculture Ministry in others. Further, a number of institutionalised mechanisms exist to link the councils and their research priorities and programmes with the development objectives of the government.

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* *Strategic Planning for National Agricultural Research Systems, ISNAR Working Paper No. 26 Marie-Helene Collin, 1989.*

There is provision for scientists to do basic research, but most of the resources are allocated to applied and adaptive research in pursuit of such objectives as self-sufficiency in foodgrains, import substitution and export promotion, helping the small and marginal farmers to increase their production and profits, and increasing the production of industrial commodities like cotton and jute.

Problems arise, however, when it comes to setting of periorities in a systematic manner. Few formal methods are used so that the allocation of resources for research on different commodities and on natural resource management cannot be defended on rational grounds and has little transparency about it. The most that can be said is that the senior research managers use their informed judgment while making allocation of resources. This in practice may mean perpetuation of a practice which started in the past without any clear analysis. This is surprising considering the fact that the South Asian countries have enormous resources of manpower in such areas as social and management sciences, in addition to their large pool of agricultural scientists. It should not be difficult for them to employ a formal framework such as a weighted objective scoring method or a cost benefit analysis approach. The result is that their limited sources are not always put to the best use.

As regards programme formulation, it would be true to say that scientists, in general, are able to address through their research some of the most pressing problems of agricultural production in the country. They are not free to pursue their academic agenda as happens in some developing countries. The focus on well defined development objectives is particularly great in the case of the nationally coordinated programmes. These are well planned with research objectives clearly defined. The different research centres from across the country cooperating in these national programmes have their task clearly spelled out and they report on their performance during the annual workshop of all the participating scientists. There is an element of healthy competition between the different centres.

When it comes to programme formulation at the experiment stations beyond the nationally coordinated programmes, the position is not very satisfactory. The first common failure is on the part of the senior managers of the system who do not always communicate in clear terms the priority areas which the institute should be addressing. In the absence of this, the director of the institute and the staff using internal mechanisms of a committee structure come out with a research programme which is often too large. It is not that the scientist fail to address some of the more important problems; the difficulty is that they try to do too much with limited resources with the result that the quality of the work suffers. Ideally, groups of scientists should be assigned to well defined programmes and projects. This does not always happen.

Closely related to the issue of programme formulation and implementation is the important function of monitoring and evaluation. This is perhaps the weakest link in the management of agricultural research systems in the South Asian countries. It is true that formal reporting mechanisms do exist whereby scientists are required to report periodically on the progress made by them. However, this has become a ritual and very little useful feedback is received by the scientists. One reason is that the senior scientists who should be providing such feedback are often too busy with administrative work in the absence of decentralisation and delegation of responsibility.

Also, the culture of receiving constructive criticism in a healthy spirit has not been cultivated in the agricultural research systems of the South Asian countries. The need is to introduce a system of peer review, first through periodical seminars when each scientist should be asked to present his/her work and receive comments from other participants. Second, the reporting procedures should be improved so that a peer group assists the Head of the Department/Programme/Leader/Coordinator in assessing the quality of the work reported by the scientist. This will inspire greater confidence in the feedback received

and will make the process more transparent. Normally, monitoring of research work should be done by the programme leaders and other senior scientists as they go round the research fields and laboratories and have friendly discussions with the concerned scientists. If this becomes a regular practice, the need for radical corrections at a later stage is often avoided.

Finally, the available literature in the field of monitoring and evaluation to provide useful guidelines to research managers is limited and an obvious need is for institutions like ISNAR to come out with suitable frameworks for this purpose. It should be useful to analyse the experience of the developed countries in this regard and see how they are able to send right messages to their scientists in the course of their work so that mid-course corrections can be made and the final evaluation on the completion of the project leads to something more positive than a mere record in the archives of the system.

4. Country specific observations

It should be stressed that these general observations apply in varying degrees to the different agricultural research systems in the South Asian countries. A number of them have experimented with improved management procedures and have achieved considerable success. Both PARC and BARC, for example, have in recent years attempted to use formal methods of priority setting, working in collaboration with institutions like ISNAR. BARC has nearly completed a major exercise in this regard whose results, however, have yet to be implemented. In the absence of this, the linkage between national research priorities and resource allocation continues to be poor.

The newly created Council for Agricultural Research Policy in Sri Lanka has also been active in organising a major study on priority setting and resource allocation. The allocation of resources to different institutions and research programmes in that country is being influenced to a significant extent by the results of this exercise. The ICAR in India has recently set up a planning unit for this purpose. The ICAR already has a National Academy of Agricultural Research Management which specialises in research management and organises training courses for the scientists in different areas including research policy, planning, organisation and management. Its work, however, has not had much influence so far on the management of the national research system. The general perception is that the Institute should have a strong component of social and management scientists on its staff.

Of the smaller systems, Bhutan in the last three years has done a good job of priority setting and resource allocation around research on different production systems. The recently set up National Agricultural Research Centre in Nepal would no doubt be embarking on a similar exercise.

Coming now to some of the other research and management functions, coordination of research particularly at inter-institutional level has made considerable progress. The nationally coordinated programmes have been the main instrument of such coordination. While India has a long history of implementing a large number of these programmes, (more than 70), Pakistan had 30 of them functioning successfully in 1986. For Pakistan it has been an important mechanism to bring together scientists from its well established provincial research institutes and the newly organised federal research centres. The success of these coordinated programmes has depended on the fact that the council provides much of the funding support for the research component of the programmes at each of the cooperating centres. Also, there is a national coordinator, a widely respected scientist who is able to communicate effectively with the senior managers of all the institutes by virtue of his/ her personal standing.

As regards coordination at the level of the individual institutes, much remains to be done to bring scientists from different disciplines together. In the South Asian countries research institutes and

even smaller stations generally have a departmental structure based on different disciplines. They do not have the kind of programme structure which is commonly found in some of International Agricultural Research Centres like CIMMYT. It becomes difficult, therefore, to organise truly multi-disciplinary research programmes. The linkages are often informal with the concerned scientists meeting together and discussing their respective projects. The need obviously is for an institutional mechanism to establish interdisciplinary groups which would bring together scientists from the different departments. These groups built around a commodity or natural resource must formally meet for the purpose of planning and implementing their research projects. It may not be possible to do away with the departmental structure in many of these countries, nor it may be desirable to do so, but is should be possible to create another institutional mechanism so that multidisciplinary groups can function effectively.

The links with the extension services, in general, are good. As far as the state agricultural universities and the regional experiment stations are concerned, they maintain close contacts with the extension services and with the farmers through their programme of demonstrations, operational research and workshops and meetings. Both in India and Pakistan, the State Agricultural Universities have a separate Director of Extension responsible for the first-line extension activities. In India, the ICAR also has a major programme of Krishi Vigyan Kendras (farmers' training and demonstration centres). These centres which are managed by one of the ICAR institutes or one of the universities is an important meeting place for the scientists, the extension staff and the farmers. The aim is to have atleast one such centre in each district of the country. It should be stressed again, that the responsibility for transfer of technology to farmers rests with the Department of Agriculture in the state and what the research institutions do is to link up effectively with the extension staff of these departments.

In a country like Sri Lanka where the planters' organisations are very well established, the research institutes working on export crops like tea, coffee, coconut and rubber work in close collaboration with them both for the programme developnment and for the transfer of results. In Bangladesh, BARC has taken an important initiative in setting up a major committee at the national level which brings together scientists, extension personnel, agribusiness companies and agricultural administrators for the purpose of identifying mature technologies to be recommended to farmers. Major institutes like BARI and BRRI have strong divisions of farming systems research with major involvement in on-farm research. In Bhutan, as we saw earlier, the recent reorganisation has brought the research and extension services under a single organisation. The position in Nepal is similar to that of countries like India, Pakistan and Bangladesh.

The personnel policies of the research systems in the South Asian countries could do with considerable improvement. In general, and specially in the larger countries of India, Pakistan and Bangladesh, the systems tend to be overstaffed. Not only do they have large groups of scientists but also a large number of technicians, non-technical supporting staff and administrative personnel. The result is that the balance between salary costs and operational funds for carrying out research is not favourable. The solution for this lies not with the governments but with the research managers who fail to allocate resources on the basis of clearly defined priorities.

In India and Pakistan, recruitment of scientists is on the basis of open competition with merit being the main consideration. India in recent years has set up an independent Agricultural Scientists Recruitment Board with mixed success. In Bangladesh, selections are made by committees constituted by the government and they meet only occasionally. The result is that a large number of senior positions in the research institutes and in BARC remain vacant for a number of years. In Srilanka, Nepal and Bhutan, the established government procedures and rules for civil service apply for scientific recruitment.

Hardly any country in the region has evolved a system of reward and promotions for scientists who do good work. The ICAR in India experimented for ten years with a system of in situ promotion but it did not work. The Council now follows the rules and regulation for staff promotion similar to those of traditional universities.

IX. FUTURE DIRECTIONS

1. Decentralisation

When the agricultural research systems in the South Asian countries were reorganised in the 1960s and 1970s, the need obviously was for a strong central body which will formulate policies, develop the necessary network of experiment stations, and provide them a clear sense of direction for development-oriented research. The need today is of a different kind - for a greater degree of decentralisation, specially with increasing recognition of the improved role of regional research and taking into taking into consideration the enormous increase in the size of many of the systems. India in particular has followed the model of a strong, highly centralised research council. PARC appaears to be well on its way to have a large number of research institutes of its own, some of them with a very large number of scientists. Both will be called upon to decentralise some of their administrative functions to the staff of their institutes. The systems are too large to be managed from a centralised council in the capital. Recent reviews of the ICAR have already proposed that strategic planning, priority setting, resource allocation, coordination and monitoring should be its main responsibility rather than the direct administration of its many institutes. This logically would also be the route which PARC will be expected to take in the years to come as the system grows in size.

2. Rationalisation of research station network

As regards the research station network, it will have to be rationalised. The concept developed in India in the last 10 years has been to strengthen research capacity in the different agro-climatic zones, 127 of which have been identified. The idea is that a great deal of technology has to be location-specific responding to the needs of the farmers in each of the different agroecological regions in the remote parts of the country. This has meant strengthening the research station network of the State Agricultural Universities.

A deliberate policy decision was taken with support from the World Bank that further expansion of the research infrastructrue will be mainly in the states so as to provide this kind of agroecological coverage for the 127 zones. In most of these zones, a Regional Research Station with multidisciplinary teams of scientists has been set up with additional responsibility to coordinate the work of the smaller stations. PARC has continued to strengthen its federal network of institutions in the different regions providing support at the same time to the provincial institutions for greater agro-ecological coverage.

This raises the question of the relationship between the federal institutes and the regional research centres in the states. In the years to come, a new relationship should evolve with a clear division of responsibility. The federal institutes will be called upon to do the more advanced basic and strategic research and to perform a service function for the regional institutions. They will also be distributing improved germplasm to the regional centres for adaptive and applied research in response to local needs. In a sense the federal institutes in these two large countries will be asked to provide the same kind of research support to the regional institutions as the international agricultural research centres currently provide to the less developed national research systems. For example, research on multiple and durable

resistance to diseases and pests and in modern biotechnology will be largely carried out in federal institutes, with the regional centres using some of the material and concepts developed in the course of this work.

As regards Bangladesh, the need will be of a different kind. Although the Bangladesh Agricultural Research Council has been given major responsibility for research planning and coordination, it has little institutional authority to do so. The ten major institutes in Bangladesh are autonomous bodies and are not administratively linked with BARC. The first major requirement of the research systems in Bangladesh would be to give BARC the same kind of institutional position as is available to ICAR and PARC. This does not mean that BARC should take over the administration of the ten institutes. But it should have the necessary authority to be recognised by the institutes as the apex research organisation which would approve their programmes and budgets. Following this, the existing research station network will have to be rationalised. The Bangladesh Agricultural Research Institute, (BARI), for example, is too large to be managed efficiently. Also, the location of regional stations does not fully correspond with the research needs of the different agroecological regions.

In the case of Sri Lanka, the obvious need is to make the recently set up Council for Agricultural Research Policy(CARP) fully functional. CARP has been given an important mandate but does it have the institutional clout to perform it? This is an issue which will require careful consideration. The reorganised research system in Nepal is in early stages of its evolution and it is not possible at this stage to comment on its future direction. Bhutan has made a good beginning with its new structure and production system based programmes.

3. Research policy

An important conclusion which emerges from this discussion is that the agricultural research management systems in the South Asian countries will see a major transformation. If in the past 25 years the research councils had to be administratively strong and centralised to be able to deliver the desperately needed new technologies, in the next 25 years they will have to concentrate more on research policy and planning and coordination and monitoring. What kind of factors will determine the new research policy? One of the compulsions will arise from the fact that while the South Asian countries have made impressive progress in increasing their food production in the past 25 years, in no other region of the world will the population pressures and the need for a continuing increase in agricultural production be greater than in these countries. At the same time, it will become more difficult for The South Asian countries to maintain high growth rates in food production now that the yields are already quite high, at least in the more favourable areas of the irrigated and high fertility lands. One of the technological challenges will be to further increase the productivity of these lands in a sustainable manner.

A. New technology for stress environments: A more difficult challenge will be to develop a new kind of production technology for the dry, marginal and eroded lands with problem soils. The food needs of the South Asian countries in the next 25 years could not be met from the high productivity potential areas alone. The dry and the low fertility lands will have to be fully harnessed and there is not much improved technology available for this purpose. The focus will have to shift from genetic improvement to management of natural resources of lands, soils and water if the productivity of these lands is to be increased. This will call for a major reassessment of priorities and training of scientists. In the past, research systems in South Asia have tried to buy time to address the problems of these difficult agro-ecological situations, but that time has now come. A major issue would be one of increasing the

productivity of these lands while maintaining their sustainability taking into consideration the fragile nature of their ecosystems.

B. Biotechnology: A second compulsion for policy review comes from the rise of biotechnology. Agricultural research systems in South Asia are already being called upon to take important decisions with regard to investment in biotechnology research. Many people believe that the greatest promise of biotechnology is for the resource poor farmers as it should help to substitute the present high cost non-renewable resources of energy on the farm with inputs of a renewable kind, such as the biologically fixed nitrogen. This could be the ultimate revolution in farming giving rise to a high-yield agriculture without dependence on environmentally unfriendly and expensive industrial inputs. The genetic transformation technology already promises to introduce genes from bacteria into crop plants to make them pest resistant. In the short term, there are many contributions which biotechnology can make, and the South Asian countries are in a particularly fortunate position to take advantage of them. Examples of these simple biotechnologies with immediate pay-off include micro-propagation of horticultural and plantation crops through tissue culture, production of disease free clones of root and tuber crops, and improvement of animal nutrition through bioconversion of straw and crop residues.

What kind of institutional framework should the South Asian countries create to be able to take advantage of these developments in biotechnology? It may be necessary for some of them to set up new biotechnology laboratories for the more advanced work involving recombinant DNA techniques so that a large number of young scientists could be trained in these modern methods. At the same time biotechnology must be incorporated into some of the ongoing research programmes such as those in the field of horticulture and animal nutrition so that there is a close linkage between the new group of researches and those already involved in generation of improved production technologies.

C. Links with private sector: Finally, the agricultural research institutions in the South Asian countries will be called upon to develop closer links with agri-business and with the private sector in general. There is hardly any other region of the developing world where the public sector research institutions have received so much attention in the past 25 years and those in the private sector so little. The history of agricultural development in the industrialised countries shows that as the government funded systems have evolved and matured, they have transferred many of their responsibilities for research and research-related services to the private sector. In the Latin American countries and to a lesser extent in the countries of South-east Asia, the important role of the private sector in agricultural research has received much greater attention in recent years compared to the those of South Asia.

Three factors will determine the increasing partnership of the private sector with public sector institutions in the conduct of agricultural research. First, the government funded research institutions, as we saw earlier, will be working on new priorities, specially in the area of natural resource management. They can best do this if they pass on some of their existing research responsibilities in the field of plant breeding, fertilisers, pesticides and farm machines to the private sector. Indeed, a large part of the adaptive and some of the applied research in these fields should be a major responsibility of the private sector. They should be doing this kind of research as part of their efforts to promote the sale of modern farm inputs which they produce. Secondly, the emergence of biotechnology has created a new situation, for the first clients of the products of such research will not be the farmers; in many cases they will be the agribusiness companies. For example, the nitrogen fixing bacteria or techniques of micro-propagation for horticultural crops can reach the farmers only if agribusiness companies first take up the commercial production of these inputs.

A good example to emulate would be the Food and Agricultural Research Council in the United Kingdom which has established an Agricultural Genetics Company that derives much of its funding support from the private sector. The Council scientists employed in this institution work in close collaboration with managers of the private sector companies which provid the funds.

Thirdly, the economic reforms and the liberalisation measures which are now underway in the countries of South Asia envisage a much bigger role for the private sector. Part of this role will be in the field of agricultural research, agro-processing for exports, and in the development of a strong infrastructure of support services to the farmers.

The whole field of closer links between research institutions in the public sector and agri-business is so important that it needs to be discussed in a separate paper in its own right. The senior managers of research systems in the South Asian countries in the course of their exercise on strategic planning will be devoting considerable attention to this aspect.

Some of the major issues that will require consideration in the context of the new policy are listed below.

Biotechnology	**Sustainability of Agricultural Production System**
* National biotechnology strategy * Priorities - short and long term * Institutional framework and integration * Human resource development * Link with the private sector: joint venture and contract research * Management of intellectual property rights; patents * Biosafety an regulatory issues	* Review of priorities and programs * Reallocation of research budget * Scientific resources and leadership for natural resource management * Emphasis on-farm and socio economic research * Agroecologically based experiment stations

APPENDIX I

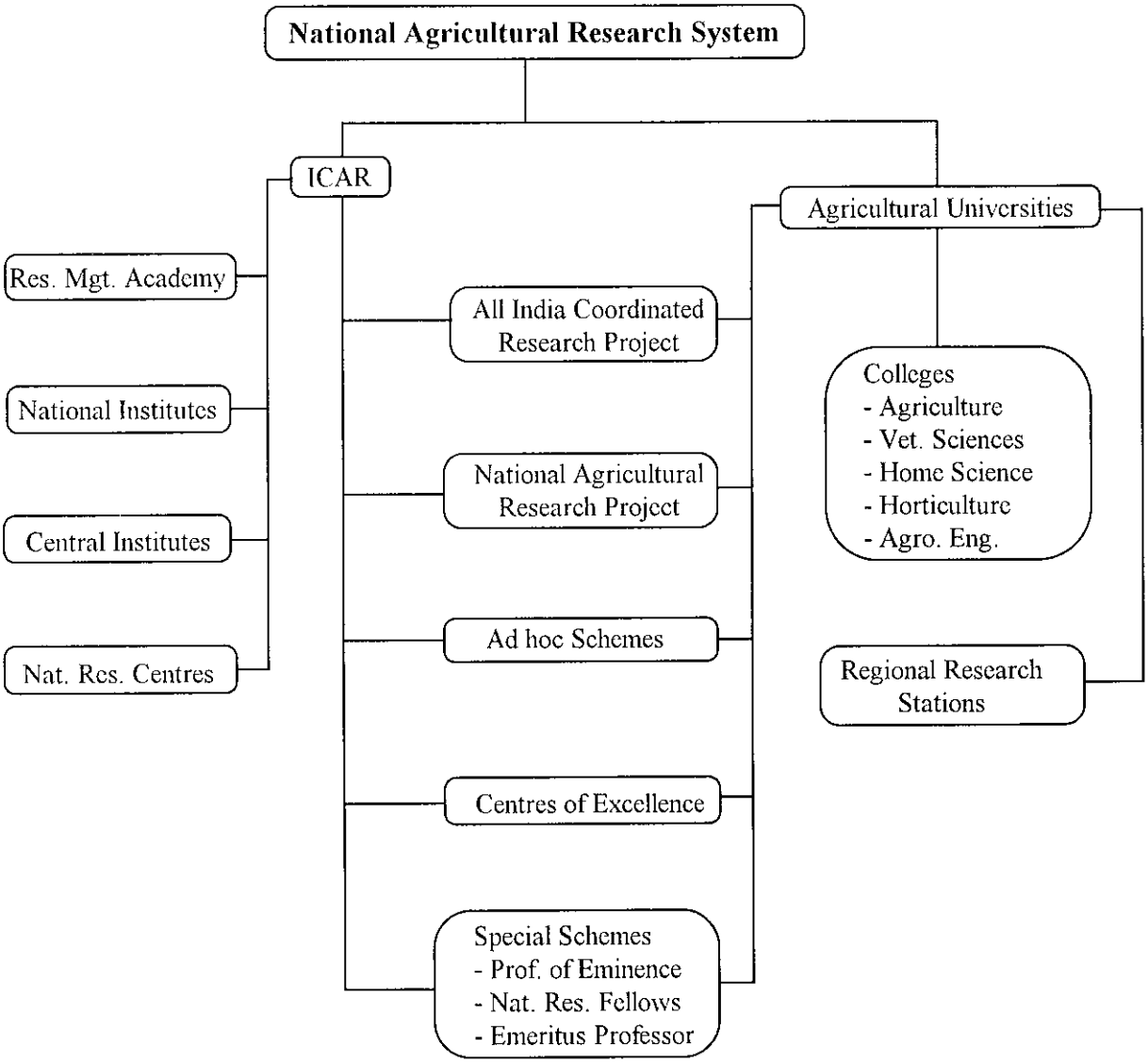

Fig. 1: Agricultural Research Systems in India

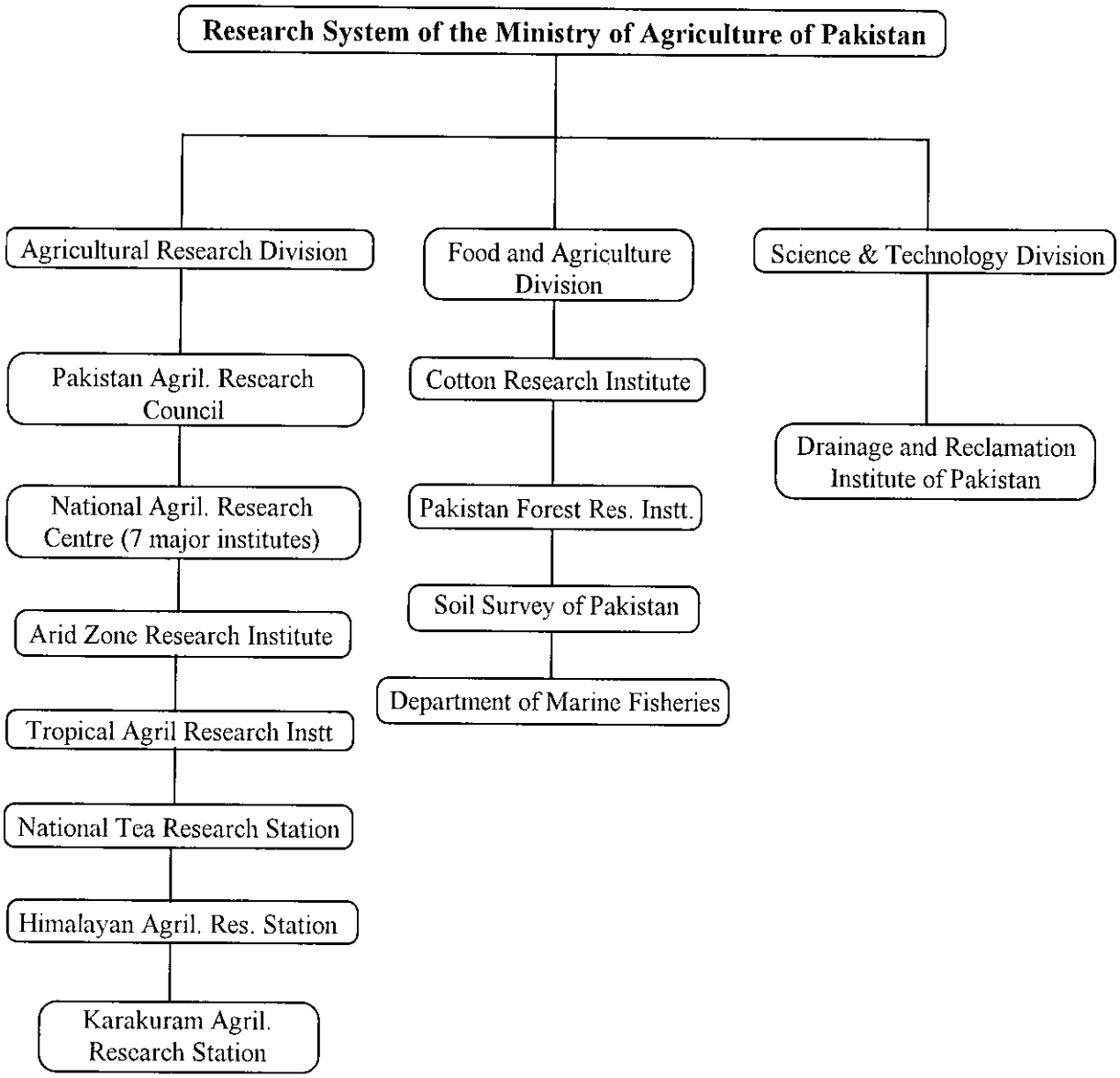

Fig. 2: Research System of the Ministry of Agriculture of Pakistan

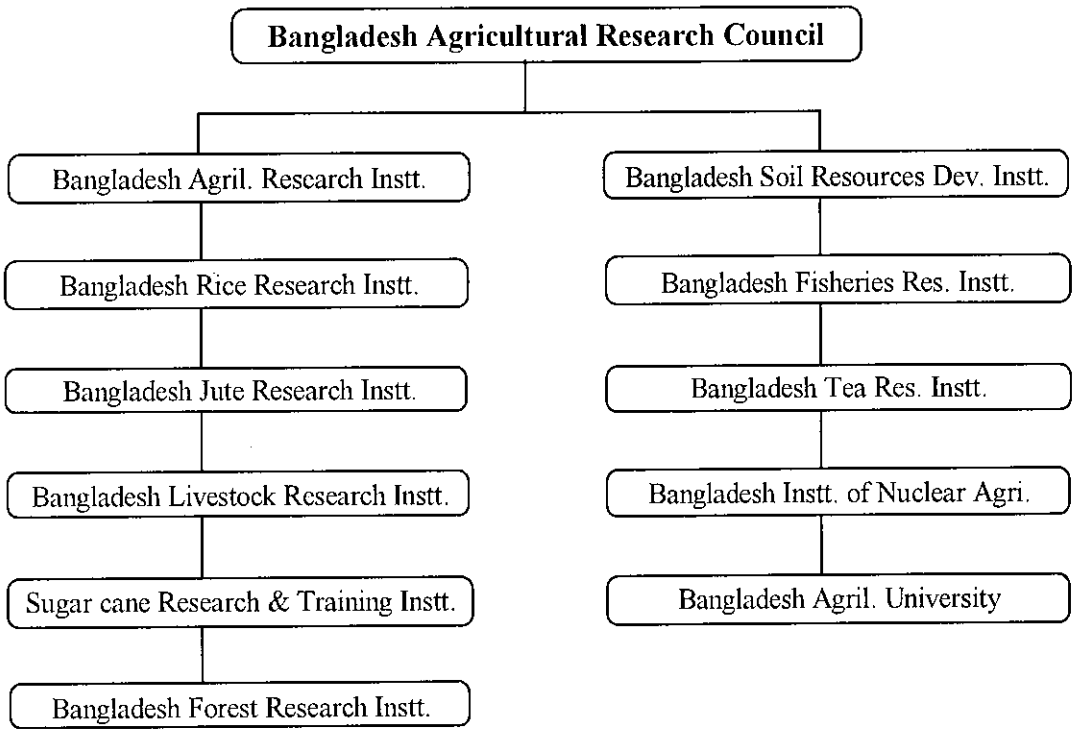

Fig. 3: Organization of Agricultural Research in Bangladesh

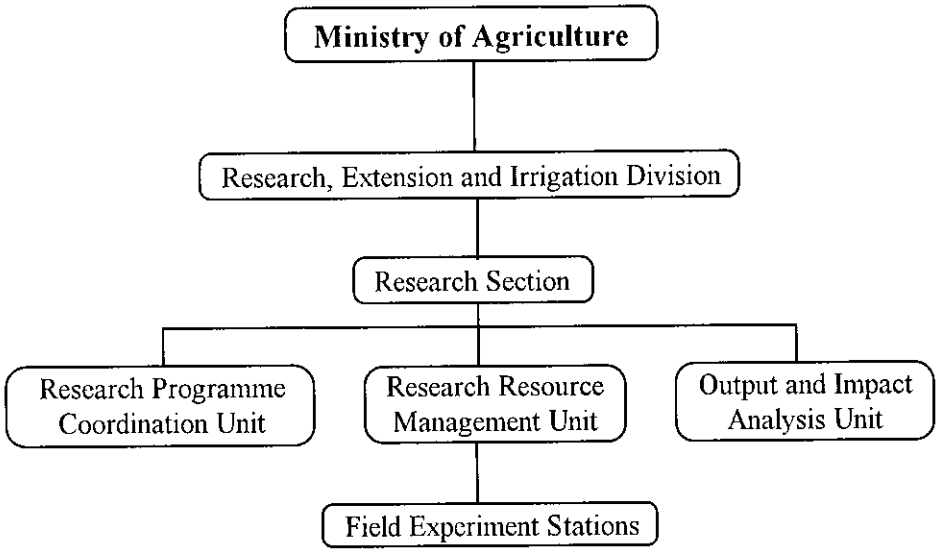

Fig. 4: Organization of Agricultural Research in Bhutan

Ministry	Research Institution
1. Agricultural Development and Research	1. Department of Agriculture 2. Department of Export Agriculture 3. Department of Animal Production & Health 4. Agrarian Research and Training Institute
2. Plantation Industries	1. Tea Research Institute 2. Rubber Research Institute 3. Coconut Research Institute 4. Sugar cane Research Institute
3. Fisheries	National Aquatic Research Agency
4. Lands and Mahaweli Development	Forest Department
5. Higher Education	Postgraduate Institute of Agriculture

Fig. 5: Agricultural Research System in Sri Lanka