CAPACITY-BUILDING FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN PAKISTAN

Muhammad Afzal*

ABSTRACT

Agriculture continues to be mainstay of economy in the developing countries. In Pakistan it contributes 25% to the national GDP and more than 44% of the labor-force is engaged in this sector. It is a major source of export-earnings and also provides raw materials for the local industries. There are wide differences in agricultural productivity of developing and developed countries: on an average, it is almost double in the developed countries. To reduce the gap, there is a need for a proper R&D infrastructure and enabling policies that can improve production with technologies that are easily adaptable by the farmers and are environment- friendly. In this competitive world, only science-based agriculture will flourish. The focus of research should be to improve genetic potential of crops and animals, for both yield and quality and to enhance efficiency in resource-usage.

National Agricultural Research System (NARS) in Pakistan, like the other developing countries is limited in size, funding level and quality of scientific and professional staff, to tackle the issues. Thus, capacity-building of these scientists, professional staff and, most importantly, the farmers should greatly support agricultural development in the country. Several training-program initiatives have proven to be very successful in the past, and the current models are even more advanced, being based on Information-Technology. In the strategy for capacity-building, universities are key players, by being the knowledge-engines and providing quality-graduates to NARS, extension system and the industry.

INTRODUCTION

Agriculture is the mainstay of Pakistan's economy. It contributes 25 percent to the national GDP and employs over 44% of the labour force. Pakistan's foreign- exchange earnings are also dependent upon agriculture. Agricultural commodities account for 15% of export, while agro-based industries contribute 65% to the export (Government of Pakistan, 2002). Major industries in Pakistan are also dependent on agriculture for the raw materials. Review of the ups and downs of Pakistan's economy in the last 53 years clearly indicates its heavy dependence on agriculture. Agriculture will continue to be the corner stone of Pakistan's economy for the next decade (Afzal, 2001).

Although currently rated as a food-secure country by FAO, Pakistan requires major improvement in agricultural productivity to satisfy the growing population with higher income in the coming years. Current production-levels, as well as future projections of major agricultural commodities, are shown in Table-1.

Pakistan's agricultural system is highly complex. This ranges from high mountainous areas, in the north, to very hot deserts and Indus delta, in the south. Thus several distinct agro-ecological zones and sub-zones exist, with wide diversity in climate, soil and natural vegetation. Furthermore, attitudes, problems and competence of large, medium, small and landless farmers in each region, and even in a village, vary drastically in the management of their resources. This means that, for improved agricultural production, there is a need for a large number of technology-packages if a visible impact has to be demonstrated (Afzal, 2001). These challenges can only be met through a vibrant and well-organized agricultural research system in the country. Without full backing of such a research system, agricultural productivity soon becomes static and will not be able to satisfy the rapid increase in population and rising income-levels.

AGRICULTURAL DEVELOPMENT IN PAKISTAN

Pakistan has made tremendous progress in agricultural development since its independence. The country used to import its main staple food i.e. wheat in large quantities. It has not only attained self-sufficiency but is exporting wheat for the last three years. Significant progress has been achieved in improving yield of all major agricultural commodities. Off-season vegetables-growing technology provides fresh vegetables around the year. Yields and quality of fruits and vegetables have been improved and new vegetables and fruits have been introduced in the

* CSO, Animal Sciences Division, Pakistan Agricultural Research Council, G-5, Islamabad. E-mail: afz-parc@isb.paknet.com.pk

Table - 1: Projections for Agricultural Commodities in Pakistan

(000 tonnes)

Commodity	Current Production (2001-2002)	Projected Production (2010)	Growth rate (%)
Wheat	18, 475	26,443	2.93
Rice	3,882	6,300	3.17
Maize	1,665	2,500	5.94
Cotton (Lint)	1,805	3065	5.78
Sugarcane	48,042	60,000	1.00
Pulses	577	1,512	1.00
Oilseeds	4,040	9,430	3.87
Potato	1,679	2,233	3.81
Milk	27,031	34,310	3.80
Meat	2,072	2,652	3.90
Eggs (million No.)	7,679	14,129	7.00
Fish	655	1115	5.64

Source: Agricultural Strategies for the First Decade of New Millenium (2000)

country. Mushrooms are being cultivated locally. New dairy products like cheese, yoghurt, and UHT milk of local origin are easily available, and fish-farming has been introduced in the country. Although it is not pertinent here to exhaustively review all achievements in agricultural development in the country, a few typical examples are given in the following paragraphs to highlight the progress made so far.

Being the staple food, wheat has always been important in Pakistan's agriculture. It is grown on 70 percent area in the Rabi (winter) season. Average annual production of wheat in Pakistan increased from 3.25 million tons in 1950-55 to 13.47 million tons in 1985-90 and 19.53 million tons during 2000-02. Wheat-yields during this period also showed a similar trend. Wheat-yields were in the range of 625 to 850 Kg per hectare during 1948-63, which increased to 1070 to 1316 during 1968-1978, 1679 to 1999 during 1983-1993 and ranged from 2170 to 2491 during current years, i.e. 1998-2002 (Figure-1). Rust epidemics that used to destroy the wheat-crop almost every 5 years have completely been controlled by a programme of continuous monitoring for rust-resistance of all varieties (Hashmi and Chaudhri, 1994).

Rice is an important export-crop of Pakistan and, in some years, has been the largest single export item of the country. Pakistan grows and exports a fine, aromatic basmati rice. International Agricultural Research Institutes did not conduct research on this type of rice and the country had to depend upon indigenous research capabilities for improvement of germplasm and production-technology (Akbar and Amir, 1994). Pakistan produced 0.69 million tons of rice in 1947. The production of rice has steadily

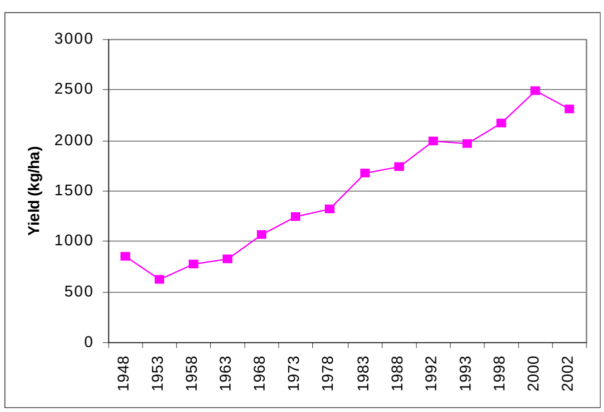

Figure - 1: Wheat Yields in Pakistan

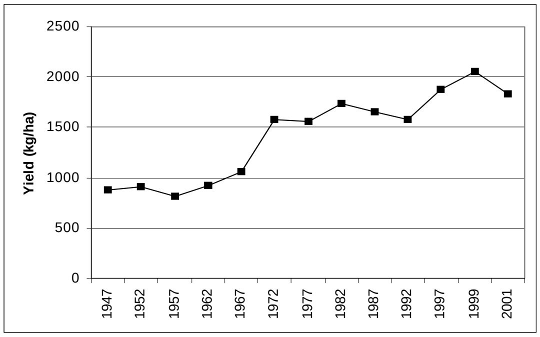

Figure - 2: Rice Yields in Pakistan

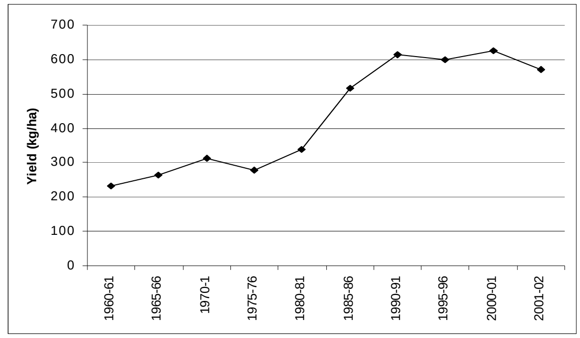

Figure - 3: Cotton Yields in Pakistan

increased and was 1.50 million tons in 1967, 2.95 million tons in 1977, 3.24 million tons in 1987 and 5.16 million tons in 1999. Corresponding yields have also increased and are 877, 1056, 1553, 1651 and 2050 kg per hectare (Figure-2).

Cotton is the single most important crop in Pakistan's economy. Raw cotton and textile-products are also the largest export-item of the country. Cotton-yield in Pakistan was very low and averaged around 235 to 300 kg per hectare in the 60s and 70s. The yield, however, almost doubled with the introduction of a locally developed variety i.e. NIAB-78. Cotton yields in Pakistan are shown in Figure-3. This single technology, developed from local research and development efforts, had a significant effect on the economy of Pakistan.

In the livestock sector, milk production has continuously been increasing and currently stands at 27.03 million tons, making Pakistan the 5th largest producer of milk in the world. Major epidemic diseases, which used to kill hundred thousands of animals each year, have been controlled through locally manufactured vaccines. Pakistan has recently declared provisional freedom from Rinderpest (the cattle plague) and is on its way to eradicate the disease and infection from the country by 2006-07. Poultry-sector has made tremendous progress during the last 40 years, with annual growth-rate of 10 to 20 per cent. Although, originally, day-old chicks were imported but now there are breeders, parents and even grand-parents being reared in the country. Local Research & Development institutes have particularly been providing technical guidance in feed-formulation and disease-control strategies. Even when an absolutely new viral infection i.e. Hydropericardium Syndrome hit the poultry, the local R&D institutes came to the rescue and not only diagnosed the infection but also developed a vaccine which has helped to control the disease.

Inspite of progress made in agricultural production, we not only lag behind the developed world but there are still tremendous yield-gaps between national averages and production obtained at research stations in the country (Table-2). This clearly indicates that there is need to improve agricultural extension service and policy-instruments.

NATIONAL AGRICULTURAL RESEARCH SYSTEM OF PAKISTAN

Agricultural research is a complex process. Its canvas spreads from basic and fundamental research, at one end, to adaptive or site-specific research, at the other end. There are a lot of shades in between these; the important ones being strategic and applied research. The boundaries of this classification are also not very sharp and, in many situations, one type slides into the other. Other than these, there is farming-system perspective of research in the agriculture. Agricultural research in Pakistan currently being undertaken can best be described as "maintenance research". This usually will be able to tackle national emergencies like plant and animal diseases, but cannot be expected to result in a quantum jump in the agricultural production in the country (Afzal, 2001).

The roots of agricultural research in Indo-Pakistan can be traced back to Imperial Council of Agricultural Research (ICAR), established in undivided India in 1929. It established several central research institutes. Unfortunately, all central research institutes established by ICAR were left in India at the time of partition and there was virtually not a single central institute located in the territories that constituted Pakistan. The only research establishments in

Table - 2: Yield-Gaps of Major Food Crops in Pakistan

Crop	Potential (kg/ha)	Average Yield (kg/ha)	Yield gap (%)
Wheat	6,400	2,200	191
Rice (paddy)	9,500	2,000	375
Cotton	1,400	500	180
Maize	6,944	1500	360
Sugarcane	100,000	46,000	248
Sunflower	2,500	1,000	150
Potato	3,128	1,000	210
Citrus	30,000	9,200	226
Mango	25,000	9,300	169
Apple	32,000	10,400	208

Source: Agricultural Statistics of Pakistan (2000-2001)

Pakistan at the time of independence were the provincial research stations that were established to undertake applied and adaptive research on the agricultural commodities of the provinces (Nagy and Quddus, 1998).

The National Agricultural Research System (NARS) in Pakistan consists of federal research establishments, provincial research institutes, agriculture universities and private agricultural research. Major agricultural research establishments in the federal government belong to Ministry of Food, Agriculture and Livestock (PARC, Central Cotton Committee, Pakistan Forest Institute and Soil Survey of Pakistan), Ministry of Commerce (Pakistan Tobacco Board), Ministry of Education (Centres of Excellence in Marine Biology and Water Resources Engineering) and Pakistan Atomic Energy Commission (NIAB, NIFA, AEARC, NIBGE). Some research on specific problems is also carried out in research centres of Ministry of Science and Technology and WAPDA. There are four Agriculture Universities in the country, located in Peshawar (NWFP), Rawalpindi (Punjab), Faisalabad (Punjab) and Tandojam (Sindh). Gomal University (NWFP) has a faculty of Agriculture and a College of Veterinary Sciences and there are five agricultural colleges located in D.G.Khan, Multan, Dokri, Quetta and Rawalakot (Azad Jammu & Kashmir). Veterinary college located in Lahore (Punjab) has recently been upgraded to University of Veterinary and Animal Sciences. Provincial research institutes carry out applied research and these are more geared towards developmental activities than hard-core scientific research. Each province has a central multi-disciplinary research institute on crops that are located at Tarnab, Faisalabad, Tandojam and Sariab-Quetta. Most of the other provincial institutes are commodity-oriented experimental station with a few working on multiple disciplines. Agricultural research undertaken by the private sector is very limited in Pakistan. Fertilizer and pesticide industries put up demonstration plots and provide some advisory services.

Table - 3: Land and Livestock Productivity in Different Countries

Country/ Region	Land Productivity {average cereal yield, Kg/HA}	Livestock Productivity {average milk yield, Kg/animal}
World/ average	3,034	2,192
Japan	6,260	6,641
USA	5,865	8,388
Mexico	2,451	1,393
Bangladesh	3,246	206
Brazil	2,690	1,380
India	2,372	917
Pakistan	2,401	1,179
Nigeria	1,212	400

Source: FAO (2000) Production Statistics Series, Vol. 54, FAO, Rome.

RELATIONSHIP BETWEEN NARS AND AGRICULTURAL PRODUCTVITY

Agricultural productivity of a country can be directly related to the developmental state of the national agricultural research system. Countries with well-developed agricultural research system have higher per unit productivity of its resources i.e. land and animals (Table-3). Average cereal production per hectare in Pakistan is almost half compared to Japan and USA, where NARS is well developed. Land productivity in Pakistan is even less than Mexico, Brazil and Bangladesh, where number of scientists per hectare are more than Pakistan. Nigeria that has less-developed NARS has lower land-productivity than many developing countries (FAO, 2000).

Size of NARS in Pakistan is proportionately smaller than in developed countries and even many developing countries in the region. A total of 4341 scientists are involved in agriculture, livestock and fisheries research in Pakistan. Distribution of these scientists among federal, provincial and educational institutions is shown in Figure 4. More than half of the scientists (52 %) are located in provincial institutes. However, the number of Ph.D. scientists in the provincial research system is lowest (Figure-5). In fact, more than 52 percent Ph.Ds. are in educational institutions. Distribution of Scientists in the provincial research system is shown in Figure-6. The number of Ph.D. scientists in all provinces are low. However, the situation in Sindh, Balochistan and Azad Jammu & Kashmir is alarming and needs immediate attention if these research systems are to contribute in agricultural development. This whole situation should be seen in the context that Pakistan NARS are supposed to conduct research and development in more than 140 commodities, with focus on 10 to 14 disciplines for each commodity. Numerically, not even one Ph.D. scientist is present to work on every discipline of each commodity.

Not only the size of Pakistan NARS is small, but the expenditure on agricultural research is also very low. The current expenditure level on agriculture research in the country is less than 0.2 percent of GNP that falls short of 2.0 per cent target set by the Commission on Agriculture in 1988. Studies carried out by independent institutions like ISNAR (Table-4) clearly shows that Pakistan spends less than Bangladesh,

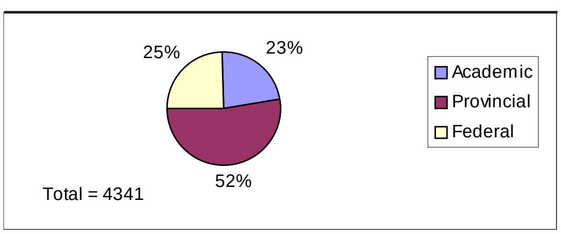

Figure - 4: NARS in Pakistan (Number of Scientists)

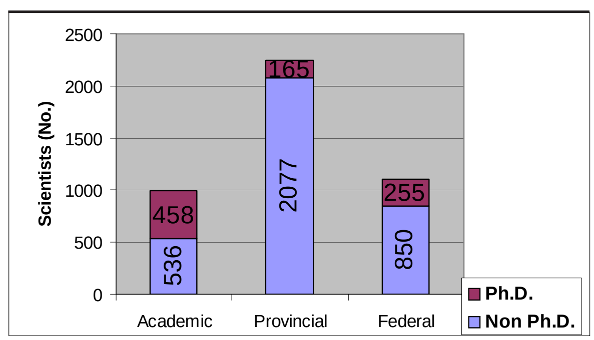

Figure - 5: NARS in Pakistan (Number of Ph.D. Scientists)

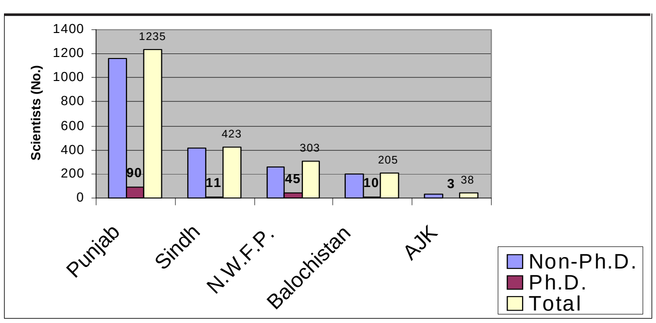

Figure - 6: Provincial Agricultural Research System

Sri Lanka, India and even Nepal on agricultural research per scientist or per hectare of the agricultural land.

CAPACITY-BUILDING

Output of an institute can be directly related to the quality of manpower employed and involved in the creative activity. Capacity-building is not a one-time activity, but is a continuous process to upgrade the expertise of the manpower.

CAPACITY-BUILDING FOR RESEARCHERS

Capacity building in agricultural sciences has mainly been strengthened in the 70s and 80s, with significant help from donor agencies. Main capacity-building activities for agricultural sciences in the past are listed below:

Local Educational Institutes

At the time of creation of Pakistan, there was only one agricultural college in Pakistan: Punjab Agriculture College and Research Institute, Lyallpur (now Faisalabad). This college, attached to Punjab University, was awarding B.Sc. and M.Sc. degrees in Agriculture. Education in livestock-sector was provided by Animal Husbandry College, Lahore, which was established in 1882. Realizing the importance of capacity-building for development of agriculture in Pakistan, the government continued to establish/ upgrade educational institutions at different locations in the country. At present, there are four agricultural universities, one veterinary and animal sciences university, 5 agricultural colleges and two faculties dealing with agriculture and veterinary sciences in a general university. All these institutes offer graduate-degrees in different disciplines of agricultural and animal sciences. Master-level programmes in various agricultural sciences are offered by 4 colleges and all universities, while universities and one college also offer Ph.D. study programmes. Training of Ph.D level scientists has been very limited. A total of less than 340 Ph.D. degrees in agricultural sciences have been awarded in Pakistan, with majority i.e. > 320 from University of Agriculture, Faisalabad.

International Agencies

Although several international agencies have contributed towards capacity-building in agricultural sciences in Pakistan, USAID and World Bank had been the major supporters of agricultural research and education (Hafeez, 1994). Historically, the efforts in development of manpower were started in 1961 when USAID supported the building and equipping of University of Agriculture, Faisalabad and provided a large degree and non-degree training-programme for upgrading the level of education of university staff (Development Support Training Project). Other major projects of USAID in capacity-building in agricultural sciences were Strengthening Research Capabilities, Management of Agricultural Research and Technology, Food-Security Management Project, Irrigation-System Management Project, Agriculture-Sector Support Project, Forestry Planning and Development Project and Transformation and Integration of Provincial Agricultural Network (TIPAN).

Under World Bank loans, Pakistan Agricultural Research and Development Project and Agricultural Research Project-II contributed significantly towards capacity-building in agricultural sciences. IDA-World Bank Third Education Project exclusively provided capacity-building to Sindh Agricultural University, Tandojam. Other significant international assistance extended for capacity-building in agricultural sciences in Pakistan include DAAD of Germany, DANIDA of Denmark, NORAD of Norway, British Council, ODA of United Kingdom, JICA of Japan, FAO, UNDP and Australian and Dutch assistance.

Efforts by the Government of Pakistan

Realizing the importance of science and technology in economic development of the country, the Federal Government has also launched various capacity-building programmes in different fields of science and technology. Agriculture, being a driving force of the economy, also got its share in these capacity-building endeavours. Ministry of Science & Technology launched Human Resource Development in High-Tech Fields project, during 1985-1992, and is currently having TROSS and Split Ph.D. Programmes. Indigenous Ph.D. and Merit Scholarship Programmes funded by MoST are also being operated by UGC (now HEC). The Ministry of Education has been encouraging talented students for higher studies abroad, through different schemes. These schemes include Merit Scholarship, Quaid-i-Azam Scholarship, Hundred Scholarships, Allama Iqbal Scholarship and COT scholarship schemes. Cultural Scholarships offered by various countries are also processed by Ministry of Education.

CAPACITY-BUILDING FOR EXTENSION WORKERS AND FARMERS

The technology and knowledge generated at the agricultural research institutes has to reach the ultimate end-users, the farmers in this case, to have impact on the crop and animal production. Most of the institutes either do not have out-reach programmes or have limited resources to carry out out-reach activity. All provincial governments have agriculture extension set-up to fill-in this gap. The basic purpose of this extension-service is capacity-building of the farmers to achieve higher sustainable productivity. For this, continuous updating of the knowledge of extension-workers is a pre-requisite. This research–extension–farmer linkage has been weak, thus there is a wide gap between yields at experiment stations and farmers' fields (Table-2). Various models have been tried in the past to improve agricultural productivity and rural development in Pakistan. These are summarized in the following paragraphs.

The Village Cooperative Movement was started soon after independence. It proposes that farmers unite under the umbrella of village cooperative societies and the thrust of the movement was education of member-farmers in new technologies. However, this movement suffered due to stronghold of rural elite on the cooperatives, lack of cooperation among Agriculture and Cooperative Departments and colonial "top down" approach (Malik, 1989). Village AID Programme (1952-1961) was started with help from forerunner of USAID and Ford Foundation. The programme sought to bring all-round development of the village, including disseminating improved agricultural technology through specially trained Village-AID workers. After an initial success, the programme became a victim of departmental jealousies and political change in the country. Basic Democracy System (1959-1970) developed awareness and local leadership among the rural masses, but failed to emphasize agricultural development.

Agricultural Development Corporations (ADC) were established to improve overall performance of the agriculture, including dissemination of information, but became farm-input suppliers. With farm-inputs devolved to other agencies and private sector, the ADC was disbanded. Integrated Rural Development Programme (IRDP) concept (1970-1978) revolved around selecting 50 to 60 villages and developing the area, through a social cooperative system under a total approach. Development of agriculture was the central force behind this rural development strategy. The programme succeeded in improving crop-production, but coordination role of IRDP was undermined due to narrow vision, jurisdictional concerns and conflict of interests of various nation-building departments. T&V Programme was sponsored by World Bank and, during the life of the project, resulted in improved research – extension – farmer linkage. However, operational funds for the programme were not provided in the non-development budget, making it virtually ineffective.

Recent model for the capacity-building of extension workers and farmers, being tried in Pakistan, is Farmers' Training Schools. It is a type of informal education. This concept brings researcher, extension-worker and farmers together on the farmers' field to jointly find a solution to the problem. Thus, farmers learn by doing. This model is currently being applied for integrated pest-management in cotton. Another effort to bring research – extension – farmer together is the use of information-technology. All available information for improved agricultural production is being compiled and put on a web-site. The extension workers from each participating district, and progressive farmers, will be able to access this web-site. An interacting forum is also being created for dialogue among the researcher, extension worker and farmers.

Table - 4: Expenditure on Agricultural Research in some of the South Asian Countries (1980 - 85)

Country	Expenditure (US $)	
	Per Scientist (000)	Per Hectare (Agri. land)
Bangladesh	64	8.52
India	54	2.63
Nepal	26	4.93
Sri Lanka	69	9.08
Pakistan	16	2.40

Source: ISNAR Working Paper No. 32 (1990).

STRATEGY FOR CAPACITY-BUILDING

Analysis of the current scientific manpower reveals that the number of Ph.D. scientists retiring or leaving the system are much higher than those entering into the system. There has been a freeze on hiring in some provinces for 10 years or so. Furthermore, majority of scientists trained through USAID and World Bank projects will be retiring in the next 5 to 10 years. Leadership crisis in some institutions and even some provinces is already evident. This scenario calls for an immediate action-plan to be developed for capacity-building in agricultural sciences for the country. Delay in doing so will result in irreparable loss to the country.

The strategy for capacity-building in agricultural sciences should at least consist of the following:

1. Strengthening infrastructure, faculty and operational funding in universities imparting education in agriculture and animal sciences.
2. Changing the governmental procedures of sending scientists on training (devolving the authority to institutional heads) and, in fact, encourage young scientists to hunt for training opportunities.
3. Instituting a system of sabbatical in all research and development institutions.
4. All development projects may be bound to have at least 25 per cent of funds allocated for capacity-building.
5. Developing a mega-project for strengthening of research and development in agriculture, with a major component of capacity-building.

Educated and skilled workforce is the basis for future development of agriculture. This workforce can only be prepared by an educational system that is based on creativity and pursuit of scientific knowledge. Furthermore, agriculture will have to be supported by (i) a network of R & D institutions that are capable of absorbing and utilizing outside information and generating new technologies for the local farming systems, and (ii) enabling policies by the government.

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