

AGRICULTURAL RESEARCH IN INDIA: AN EXPLORATORY STUDY

ANWESHA BORTHAKUR*; PARDEEP SINGH**

*Centre for Studies in Science,
Technology and Innovation Policy,
School of Social Sciences,
Central University of Gujarat,
Gandhinagar, India.

**School of Environment and Sustainable Development,
Central University of Gujarat,
Gandhinagar, India.

ABSTRACT

Agriculture is the backbone of the Indian economy which plays the most decisive role in the socioeconomic development of the country. Indian agriculture is a miscellaneous and extensive sector involving a large number of actors. India has one of the largest and institutionally most complex agricultural research systems in the world. The agricultural research system in India includes some 27,500 scientists and more than one lakh supporting staff actively engaged in agricultural research, which makes it probably the largest research system in the world. Historically, the Indian agricultural research system is the zenith of a process which started in the 19th century and which resulted in the establishment of the Imperial (now Indian) Council of Agricultural Research (ICAR) on the recommendation of a Royal Commission on Agriculture in 1929. In the present research system, the Indian Council of Agricultural Research (ICAR) at the National level mainly aids, promotes and coordinates research and education activities in the country. The development of agricultural research system in India, ever since the colonial era till today, is being tried to trace in the paper. An attempt has been made to portray the role of Five Year Plans regarding investment, technology transfer and other aspects related to agricultural development in India. Although agriculture has been playing the most vital role in Indian economy, during the course of the study, it has been observed that not much emphasis has been given to the history of evolution of agricultural research in India.

KEYWORDS: ICAR, Indian Agriculture, Colonial, Post colonial.

1. INTRODUCTION

Agriculture, as the backbone of Indian economy, plays the most crucial role in the socioeconomic sphere of the country. Indian agriculture is a diverse and extensive sector involving a large number of actors. It has been one of the remarkable success stories of the post-independence era through the association of Green Revolution technologies. The Green Revolution contributed to the Indian economy by providing food self-sufficiency and improved rural welfare. The role of national agricultural research system (the NARS) was imperative in the context of Green Revolution.

India has one of the largest and institutionally most complex agricultural research systems in the world. Historically, the Indian agricultural research system is the zenith of a process which started in the 19th century and which resulted in the establishment of the Imperial (now Indian) Council of Agricultural Research (ICAR) on the recommendation of a Royal Commission on Agriculture in 1929. Since then there was a stupendous evolution of agricultural research in India.

The main events in the history of agricultural research in India can be grouped into the following seven categories (Singh, 2001):

1. Establishment of agriculture departments and agriculture colleges,
2. Establishment of the imperial council of agricultural research,
3. Initiation of commodity committees,
4. Project for intensification of regional research on cotton, oilseeds and millets,
5. Initiation of all India coordinated crop improvement projects,
6. Reorganization of ICAR, and
7. The development of agricultural universities.

Among these, first three could be listed under the development of agriculture in the colonial era, whereas the next four were prominent in the post-colonial era.

2. AGRICULTURAL RESEARCH IN COLONIAL INDIA

The early development of agricultural research in India was associated with the reappearance of famines. This acted as a nasty reminder of the little precedence accorded to agricultural research and development in colonial India.

2.1 ESTABLISHMENT OF AGRICULTURE DEPARTMENTS AND AGRICULTURE COLLEGES

An elemental department of agriculture in India was started in the year 1871 in the form of Department of Revenue, Agriculture and Commerce. Although the chief function of the department remained revenue and there was no work on agricultural development, this did mark a commencement and appreciation of the agriculture sector by the colonial government. However, this initiative was not very significant. The accolade for this modest foundation goes to Lord Mayo who was the fourth Viceroy of India, and to A.O. Hume who was a civilian of the Bengal Civil Service and one of the founders of the Indian National Congress. Paradoxically, the department was established by the Government with a view to supply cotton to the hungry textile industries of Manchester, and not to feed the famine ravished India of 1877-78. Based on the report of the Famine Commission, the government of India was determined to set up a central Department of Agriculture controlled by the Imperial Secretariat and agriculture departments

were to be set up in the provinces to primarily look after agricultural enquiry, agricultural development and famine relief in the country. However the key duty of the agriculture departments both in the centre and the provinces lingered the same that is famine relief. In the year 1892, an Agricultural Chemist and an Assistant Chemist were allotted to look after research and teaching in India which manifested the first scientific staff in the Department of Revenue and Agriculture. Eventually, an Inspector General of Agriculture was appointed to advise the Imperial and the Provincial Governments on agricultural matters in 1901. An Imperial Mycologist was appointed in the same year, and an Entomologist was appointed in 1903. During the stern famines of 1899-1900, Lord Curzon, the then Viceroy of India, was convinced that the Government of India must urgently concentrate on the agricultural sector to overcome the damages caused by the famine episodes. As a consequence, an Agricultural Research Institute was established in Pusa, Bihar in the year 1905. Likewise, the agriculture departments in the provinces were expanded and agricultural colleges were established at Pune, Kanpur, Sabour, Nagpur, Lyallpur and Coimbatore between 1901 and 1905. However, the chief function of these colleges remained teaching and training and research activities could not be carried out due to the lack of scientific and technical manpower and finance.

2.2 ESTABLISHMENT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH (THE PRESENT DAY ICAR)

The Royal Commission on Agriculture, which was appointed in the year 1926, proposed that an Imperial Council of Agricultural Research should be set up to endorse, direct and organize agricultural research all over India. The council was supposed to guide the research activities of central and provincial departments of agriculture. As per the proposal of the Royal commission on Agriculture, the Government of India, Department of Education, Health and Lands set up Imperial Council of Agricultural Research on 16th July, 1929. The name of the council was changed from Imperial Council of Agricultural Research to Indian Council of Agricultural Research in March 1947.

2.3 THE COMMODITY COMMITTEE

Several semi-autonomous Central Commodity Committees were set up by the Ministry of Food and Agriculture that were concerned with research and development activities related to specific crops in British India. These committees were semi-autonomous bodies in the sense that they were financed partly by the government and partly by the taxes collected on the export of the concerned commodities. The Indian Central Cotton Committee was the first commodity committee to be established in the year 1921 on the recommendation of the Indian Cotton Committee (1917-18). The chief function of this Central Cotton Committee remained to be cotton improvement with special focus on the development of improved methods of growing, manufacturing and marketing of cotton. The committee achieved success in the terms that it had effectively developed 70 improved varieties of cotton, and the fiber quality of Indian cotton was also considerably improved. Most of the commodity committees related to specific crops had their own research stations or institutes which were located in the regions where the concerned crop is most widely grown. However, some other commodity committees financed research schemes conducted by the State Departments of Agriculture, e.g., Spices and Cashewnut Committee. The achievement by the Indian Central Cotton Committee leads to the setting up of

commodity committees on crops like lac, jute, sugarcane, tobacco, coconut, oilseeds, spices and cashewnut and arecanut. The Vice-President of ICAR was the President of all the commodity committees. However, there was a great necessity to conduct the researches on various crops within the different agroclimatic regions of the country as in the context of India, the soil and climate fluctuate to a great extent from one region of the country to another. These apprehensions led to the formulation of the Project for Intensification of Regional Research on Cotton, Oilseeds and Millets (PIRRCOM), which was the first step in the country towards coordinated approach to agricultural research. The Central Commodity Committees were later abolished (beginning in 1965) and the research institutes under their control were transferred to ICAR.

2.4 PLANTATION RESEARCH IN COLONIAL INDIA

The provincial agricultural departments could seldom go beyond the collection of revenue data and famine relief operations. No doubt, experimental farms had been established and in 1884. For conducting experiments the government looked more to agricultural societies than to its own agencies. The society in Calcutta (AHSI) agreed to conduct all experiments in economic products. The Government of Bengal raised its grant from Rs. 2400 to Rs. 6000 per annum.

The objectives of Agricultural and Horticultural Society of India (AHSI) were

- To obtain precise and trustworthy details as to the cost of cultivation and produce per acre of fibre-bearing plants of promising character, so that the Agriculture Department may be able to form a decisive conclusion as to the prospects of a profitable exploitation of the plants in question.
- To secure a competitive trial of machines and processes for the extraction of the fibres.

Major focus of agricultural research in colonial India was on

- Cotton
- Silk
- Tea
- Indigo

The official experimental farms were obsessed with cotton. Mounting pressure from British cotton tycoons had forced the Government of India to initiate a vigorous cotton improvement programme. However, the earlier projects of 1840s and 1860s could not be made successful mainly because of insufficient botanical knowledge or the necessary market research. Later, in 1890, the association of an expert botanist in cotton experiments was specifically called for. The cultivation and marketing of existing varieties produced a relatively stable and acceptable return to money-lenders and dealers. New and untested varieties involved different methods of cultivations and great labour input, without a higher level of output or profit, and with the risk of severe losses to each of these classes. The last quarter of the nineteenth century saw the closure

of several experimental farms. But private farms patronized by cotton mills proved remunerative. For example, the Government's Mungeli farm at Bilaspur had to be abandoned, whereas the nearby Kyragarh and Nandgaon cotton farms owned by Bengal-Nagpur Cotton Mills Company produced 6,00,000 lbs. the reason behind this could be perhaps because mills could procure cotton by advancing seeds to cultivators who employed traditional techniques, while the exercise in Mungeli failed because the government was charmed by the imported technologies and ideas. The dependence on traditional knowledge proved to be beneficial for the mills.

Same was the story with silk manufacture which was also quite remunerative and received some attention. Early research work in sericulture was conducted by W.M.H. Smith in 1814. N.G. Mukherjee, an eminent scholar, was commissioned by the Government of Bengal to investigate silk worm diseases in Bengal. He submitted a note on the decline of silk trade in Bengal and pointed out that 'while European, Japanese, Chinese silk sells at 45 francs per kilo, Bengal silk sells at 32 francs'. Mukherjee emphasized on the introduction of Pasteur's system to increase the production of cocoons and silks and advised government to establish a sericulture laboratory. However, government did not pay attention to his advice and sericulture remained a purely private concern for a long period of time. At the turn of the century Ms. Tata and Sons successfully started a silk firm in Bangalore for the introduction of Japanese methods of agriculture.

Tea and indigo formed major items of export. In the 1870s, A.W.Blyth established a process by which it could easily be known whether the merest fragment of a plant belonged to the 'theine' class or not. However, no experiment was conducted to control the scourge of blight. Although the AHSI made an attempt in this direction, it failed because of lack of funds and skilled entomologists. In 1891, M.K.K. Bamber, a chemist appointed by the joint committee of the Indian Tea Association and the AHSI, performed analysis of the soil and tea leaves, gave advice on manures, drainage, insecticides, etc., and produced a book called "The Chemistry and Agriculture of Tea". The establishment of a permanent tea research station at Toclai, Assam highlights the progress of tea research in colonial India. Almost the same thing happened in the case of indigo. Indian indigo remained unrivalled till the end of the nineteenth century when Germany perfected its synthetic counterpart. In early 1899, the Government of India deputed its agricultural chemist J.W.Leather, to tour the indigo districts of north Bihar. An indigo experimental farm was started at Dalsinghsarai in July the same year. The interests of the indigo lobby were at work behind the creation of the Pusa Agricultural Research Institute. Pusa was selected as the site because of its proximity to the plantations of north Bihar.

Botanical experiments were vital for plantation work. A horde of both amateur and professional botanists had been active since the early colonial period in India. However, the early history of botanical works in India shows that except for ferns, no special attempt was ever made to systematically survey the cryptogamic vegetation of the country.

3. AGRICULTURAL RESEARCH IN POST-COLONIAL INDIA

Since independence, there has been a substantial growth in the Indian NARS. ICAR is the chief public body at the national level for synchronizing, directing, and endorsing agricultural research and education in the country. Likewise, State Agricultural Universities are responsible for doing

the same at the state level. After independence, agricultural research was given much emphasis which in turn led to increased agricultural production and near self-sufficiency in food grains in the country.

The greater emphasis given to the agricultural research could be established by the fact that the system guided by the ICAR now has

- ✓ 49 ICAR institutes,
- ✓ 17 national research centers,
- ✓ 6 bureaux,
- ✓ 25 project directorates,
- ✓ 79 All India Coordinated Research Projects (AICRPs) and AINPs
- ✓ 607 Krishi Vigyan Kendras (KVK)
- ✓ 52 State Agricultural Universities (SAUs),
- ✓ 1 Central Agricultural University,
- ✓ 4 Central Universities having faculty of Agriculture.

The National Academy of Agricultural Research Management is yet another exclusive institution under ICAR to conduct research and training in agricultural research management.

OTHER ORGANIZATIONS INVOLVED IN AGRICULTURAL RESEARCH

- General universities, about 23 of which are involved in agricultural research,
- Scientific organizations such as the Council of Scientific and Industrial Research, the Bhabha Atomic Research Centre,
- Government departments such as the Department of Science and Technology, the Department of Biotechnology,
- Private and voluntary organizations,
- Scientific Societies

3.1 PROJECT FOR INTENSIFICATION OF REGIONAL RESEARCH ON COTTON, OILSEEDS AND MILLETS (PIRRCOM)

With the initiatives for agricultural research development, there was a need to coordinate the research on various crops, especially cotton, oilseeds and millets. Moreover, a need was felt to conduct the research work in different agroclimatic regions of the country. The first coordinated

research work on regional basis was initiated in 1956 in the form of a joint venture by ICAR and the Indian Central Commodity Committees on Oilseeds and Cotton. Eventually, seventeen centers were established across the country to perform research on cotton, castor, groundnut, taramira, jowar, bajra etc. The research programme for each region was prepared by a regional coordination committee headed by the Agriculture Commissioner of India, and approved by the respective commodity committees. A regional research station composed of full-fledged sections of plant breeding and genetics, agronomy, agricultural chemistry and soil science, plant pathology and entomology.

3.2 INITIATION OF ALL INDIA COORDINATED RESEARCH PROJECTS

The conception of coordinated projects was first instigated in relation to hybrid maize improvement as ICAR was fascinated in maize improvement following the successful approach by the USA and several other countries. Rockefeller Foundation was the organization who was actively involved in crop improvement programmes in Mexico, Central America and the Caribbean. This organization was invited to assist the maize improvement programme in India. The Ministry of Food and Agriculture under the Government of India, signed an agreement with the Rockefeller Foundation in 1956 and according to the agreement, Rockefeller Foundation was to assist in the development of

- (1) The postgraduate school of Indian Agricultural Research Institute (IARI), New Delhi, and
- (2) Research programmes on the improvement of some crops (maize, jowar and bajra, initially).

Two leading scientists who were associated with Rockefeller Foundation's Maize Improvement Programmes in Mexico and Columbia visited India to study the position of maize crop and prepared a report based on their findings. This report was scrutinized by the Botany Committee of ICAR and by the Advisory Board of the Council. This provided the basis for the coordinated maize project.

The coordinated maize project in India had proven to be the defining moment in research planning in agriculture in the country. As a result of the coordinated project, new high yielding maize hybrids became available by the year 1961. Encouraged by the success of the maize project, ICAR decided to initiate coordinated projects on other crops as well as in other areas of research e.g., animal husbandry, soil sciences, etc in the year 1965. Seventy coordinated projects on various subjects were launched within 3 years of this decision and the coordinated projects accounted for 40 per cent of the total expenditure for agriculture in the Fourth Five Year Plan. However, the advancement of the coordinated projects was critically analysed in the Fifth Five Year Plan. Accordingly, some projects were terminated, some were merged with other projects, some projects were elevated to the level of Project Directorates and some were changed to Coordinated Programmes. As a result, the number of coordinated projects decreased to forty nine in the Fifth Five Year Plan. In addition to the coordinated projects, there were some coordinated programmes running during that course of time.

3.3 REORGANIZATION OF ICAR

In 1963, the Ministry of Food and Agriculture appointed the Agricultural Review Team headed by Dr. Marion W. Parker of USDA (United States Department of Agriculture), to scrutinize the organization of agricultural research in India. The team submitted its report in March, 1964 and based on the recommendation of the team, ICAR was reorganized in the year 1966. ICAR was made an entirely autonomous organization. The ICAR was proffered the control for various research organizations under the Department of Food and Agriculture and under the Central Commodity Committees. The Governing Body of ICAR was reorganized to make it primarily a body of scientists and agriculturists. Institutes like Indian Agricultural Research Institute, National Dairy Research Institute and Indian Veterinary Institute were made National Institutes. Eventually, a policy was made suggesting that an agricultural scientist would be appointed as the chief executive of ICAR with the designation of Director General. Accordingly, Dr. B.P. Pal was appointed as the first Director General of ICAR in May 1965. Concurrently, he was the Vice-President of the Council. In order to assist the Director General, four posts of Deputy Director General were created.

In June, 1972, the Government of India appointed a committee, headed by Mr. Gajendragadkar, retired Chief Justice of India. The purpose of the committee was to review the enrollment and the personnel policies of ICAR and its institutes, and to recommend actions for the enhancement of the same. The committee submitted its report in January, 1973. A Department of Agricultural Research and Education was created in the Ministry of Food and Agriculture in December, 1973 as per the recommendations made by the committee. The Director General, ICAR was made secretary to the new department. The Minister of Agriculture was designated as the President of the council, while the Director General, ICAR, was made the Chairman of the Governing Body of the council. The functions of the Standing Committee were assigned to Scientific Panels as the Advisory Board and the Standing Committee were eliminated. The scientific panels for different disciplines were made responsible for considering and assessing the suitability for financial assistance of ad hoc research schemes. Under the Agricultural Scientists' Recruitment Board (ASRB), an Agricultural Research Service (ARS) was initiated for the recruitment of scientific personnel. A scheme for internal assessment and promotion was introduced. The entire country of India was divided into eight agroecological zones and regional committees were set up for each zone. The function of these regional committees is to review the status of agricultural research and education in the concerned regions. The Governing Body of ICAR is assisted by a Norms and Accreditation Committee, which looks after the development of Agricultural Universities and the grant of fellowships.

The objectives of the ICAR may be briefly summarized as follows:

- (1) To promote, guide and coordinated agricultural and veterinary research and education throughout India;
- (2) To train research workers by offering scholarships;
- (3) To serve as a clearing house of information in regard to research and to advise on agricultural and veterinary matters generally; and

(4) To undertake the publication of scientific papers, monographs, etc.

3.4 DEVELOPMENT OF AGRICULTURAL UNIVERSITIES

The very fact that in 1948, there were only seventeen agricultural colleges in the country shows that before independence, higher education in agriculture was almost ignored. These agricultural colleges were under the control of Director, Department of Agriculture of the respective states. However, colleges for animal husbandry, governed by the Director, Animal Husbandry of the concerned states were separate from those for agriculture. Research and extension were the responsibility of the agriculture and the animal husbandry departments of the states. At that time, the organization, staffing patterns, pay scales of teachers and financial support for research and other activities were not appropriate for a first grade education and training in agriculture.

During the years 1948-49, the University Education Commission headed by Dr. S. Radhakrishnan, suggested that the country should focus on the establishment of rural universities. Major H.S. Singh and Mr. A.N.Jha (Chief Secretary and Development Commissioner, U.P.) visited Land-Grant Universities of United States in 1950 and after coming back, advised the then Chief Minister of U.P., Pandit Govind Ballabh Pant, to set up such a university in U.P. The chief minister accepted their recommendation. This event may be regarded as the one, which led to the initiation of agricultural universities in the country. In 1955, the first Joint Indo-American Team was set up. The team suggested the founding of rural universities in each of the states in India. Accordingly, the team identified U.P. (Tarai), West Bengal (Haringhatta), Bihar (Patna), Orissa (Bhubaneshwar), Travancore-Cochin and Bombay (Anand) states to be apposite for starting such universities.

In the year 1956, a blue-print for agricultural universities were prepared and this provided the root for the proposal by Government of U.P. to the Central Government (in September, 1956) for starting an agricultural university near Rudrapur in the tarai region of U.P. The Central Government also agreed to the proposal on an experimental basis. In the year 1959, the second Joint Indo-American Team was set up. The team submitted its report in 1960. The team suggested that the Agricultural Universities should be autonomous; should consist of colleges of agriculture like veterinary, animal husbandry, home science, technology and basic sciences under them; should have inter-disciplinary teaching programmes; and should integrate teaching research extension. By the year 1961, there were demands from many states for agricultural universities and the Government of India accepted the organization of a few more agricultural universities during the Third Five Year Plan. Accordingly, the Government of India appointed a committee, headed by Dr. R.W. Cummings, for providing a model for the essential legislation by the states for the establishment of agricultural universities. The committee submitted its report in 1962 and on the basis of this report; ICAR prepared the model act for the development of agricultural universities. During the period of the Fourth Five Year Plan between the years 1960-65, seven agricultural universities were established in U.P., Orissa, Rajasthan, Punjab, Andhra Pradesh, Madhya Pradesh and Karnataka. The United States Agency for International Development (USAID) contributed significantly to the development of agricultural universities through the Land-Grant Universities of U.S.A. USAID provided assistance in the form of training of Indian scientists in the U.S.A., stationing of the U.S. scientists for teaching and

research in Indian agriculture universities and by providing a limited amount of equipments for teaching and research.

One of the important schema came when the Education Commission (1964-66), headed by Dr. D.S. Kothari, recommended that all aspects of agricultural research should be the function of agricultural universities. Consequently, the responsibility for research was entrusted from State Department of Agriculture to agricultural universities. However, this change was not consistently implemented in every state. The Review Committee on Agriculture Universities (1977-78), headed by Dr. M.S. Randhawa, made many useful recommendations for the development of agricultural universities. It noted that the quality of leadership and the financial support from the state were crucial factors in the development of agricultural universities. The committee suggested, among other things, that the Director General, ICAR, and Chairman, University Grants Commission, should be members of the selection committee that appoints Vice-Chancellors for agricultural universities. Under National Agricultural Research System, State Agricultural Universities (SAUs) are major cohorts in growth & development of Agricultural Research and Education. The state agricultural universities are based on Land Grant pattern of USA which called for the federal government to offer each state with a grant of land in order to establish university/institution. Hence the name "land grant" came into being.

One of the original objectives of ICAR was to undertake aid, promote and coordinate agricultural education in the country. But this was not put into effective practice until the reorganization of ICAR in 1966. A full-fledged Division of Agricultural Education was set up within the ICAR to fulfill this objective. The ICAR has been crucial in the reorganization of agricultural education in the country by providing the necessary supervision, schemes for improving the quality of teaching and research, e.g., centers of excellence, higher education in new areas, Professor of Eminence, faculty improvement, scholarships and fellowships and financial aid. An aid of Rs. 41 crores during 1974-75 to 1978-79 proved the large spending by ICAR. The agricultural universities have contributed to a great extent to agricultural education, research and development in the country. Many improved varieties of crops, feed and animal stocks have been developed in the agriculture universities. In other words, it could be concluded that the Indian Council of Agricultural Research (ICAR) is identical to agricultural research and education in the country. The role played by the council in the development of agricultural research and education has been quite extraordinary.

3.5 INDIAN AGRICULTURE UNDER THE FIVE-YEAR PLANS IN POST-COLONIAL INDIA

3.5.1 FIRST FIVE-YEAR PLAN (1951-56)

Indian agriculture was given the highest precedence in the First Five-Year Plan during the years from 1951 to 1956. The Plan was largely concentrating on the increasing agricultural production and strengthening of economic infrastructures like irrigation, power and transport as after independence, there was an acute food shortage faced by the country. Hence to solve the food problem priority was given to increase production of food grains. There was a remarkable increase in agricultural production during the First Plan period. A good monsoon was supportive in the success of agriculture during the First Five Year Plan period. The production of food

grains increased from 54 million tones in 1950-51 to 65.8 million tones at the end of the Plan¹. The targets sent out for the Plan were almost accomplished. Even in some cases, the targets exceeded.

3.5.2 SECOND FIVE-YEAR PLAN (1956-61)

In the second plan, emphasis was shifted from agriculture to industry and only about 21 per cent of the actual plan expenditure was spent for agricultural development. There was a shortfall in the production of all crops. However, sugarcane was an exception as its production had increased during the period of Second Five Year Plan. As a result of the disappointing agricultural production; the country had to import food grains from overseas to prevail over the food scarcity. During this Plan, an inflationary situation started emerging in the economy of India.

3.5.3 THIRD FIVE-YEAR PLAN (1961-66)

After the hard times faced during the Second Five Year Plan regarding the agricultural production, the objective of the Third Five-Year Plan was to achieve self-sufficiency in food grains and to increase the agricultural production to meet the needs of industry and export. As a result, the plan accorded higher priority to agriculture and irrigation than to industrial development. Moreover, the Plan targeted to increase overall agricultural production by 30 per cent. Nevertheless, the success achieved during the period of the Third Five Year Plan was highly unsatisfactory. The food production increased only by 10 per cent as against the target of 30 per cent. Consequently, the country has to import Rs. 1,100 crores worth of food grains to meet the domestic demand.

THREE ANNUAL PLANS (1966-69)

During periods of three Annual Plans, a high precedence was given to minor irrigation. This was followed by adoption of a high yielding variety programme to increase agricultural production and productivity. Thus, this period is considered crucial for Indian agriculture as the green revolution took place during this period and the Government set up Agricultural Prices Commission to assure minimum support prices to farmers. The Food Corporation of India was made responsible for maintaining buffer-stock to surmount fluctuation in the supplies of food grains and their prices.

3.5.4 FOURTH FIVE-YEAR PLAN (1969-74)

The Fourth Plan had two objectives in the agricultural sector. Those are

- To provide the conditions necessary for a sustained increase of food production by about 5 per cent per annum over the decade 1969-78 and
- To enable a large section of the rural population including small farmers, farmers in the dry areas and agricultural labourers to participate in the process of agricultural development and share its benefit.

The Green Revolution introduced during the annual plans had a good result. However, still the actual production of food grain was 104.7 million tones in 1973-74 as against the targeted increase of 129 million tones.

3.5.5 FIFTH FIVE-YEAR PLAN (1974-79)

During the Fifth Plan, Rs. 8080 crores (nearly 21 per cent of the plan outlay) was made for agricultural development and irrigation². The Fifth Plan accorded priority for the spread of High Yielding Variety (H.Y.V) cultivation, greater use of fertilizers, pesticides and insecticides to increase agricultural production.

The Plan further provided special emphasis on

- Small and marginal farmers,
- Dry farming technique,
- Evolving H.Y.V. seeds for other crops like paddy,
- Social conservation measures on saline and alkaline soils and for desert land reclamation.

During this Fifth Plan, there was a considerable increase in the production of food grains. But the output of pulses and oil-seeds, paddy remained stagnant and caused substantial adversity for the common man.

3.5.6 SIXTH FIVE-YEAR PLAN (1980-85)

The Sixth Five-Year Plan recognised that the growth of the Indian economy depends significantly on a rapid growth in agriculture and rural development. The main objective of the Plan, therefore, was to

- Increase agricultural production,
- Generate employment and income opportunities in rural areas and
- Strengthen the forces of modernization for achieving self-reliance.

Further, the plan aimed at accelerating the pace of the implementation of the land reforms and institution building for beneficiaries. The Sixth Plan was officially held as a great success particularly due to its success on the agricultural fund.

3.5.7 SEVENTH FIVE-YEAR PLAN (1985-90)

The Seventh Plan aimed at an annual average increase of 4 per cent in agricultural production. The Plan allocated Rs. 39,770 crores for agricultural sector which is 22 per cent of the total plan outlay³. The major programmes adopted during the plan were, a special rice production

programme in the eastern region, national water-shed programme for rain-fed agriculture, national oil-seed development project and social forestry.

Regrettably enough, the first three years of the Seventh Five Year Plan encountered poor monsoon. As a result, agricultural production received a set-back during these years. However, it increased sufficiently during the last two years for which the agricultural production recorded a creditable growth of 4.1 per cent in the Seventh Plan.

3.5.8 EIGHTH FIVE-YEAR PLAN (1992-97)

The basic objectives of the Eighth Five-Year Plan were

- To unite the gains already achieved in agricultural productivity and production during the last 40 years;
- To protract agricultural productivity and production in order to meet the increased demands of the growing population;
- To enlarge the income of the farmers;
- To create more-employment opportunities in the agricultural sector; and
- To step up agricultural exports.

22 per cent of the total plan outlay amounting to Rs. 93,680 crores was allotted for agriculture and irrigation. The Plan targets a growth rate of 4.1 per cent per annum for the agricultural sector. Thus, during different plan periods, the Government has accorded vital importance to the agricultural sector and has tried to increase the agricultural production and productivity through different policy measures like the special rice production programme, initiated by the Government in Assam, Bihar, Orissa, West Bengal and eastern Uttar Pradesh, National water-shed development programme which gives emphasis on dry land horticulture, optimal cropping system, firm forestry and fodder production. Here, the aim is to develop areas under dry land agriculture which are characterized by low productivity and high risk.

3.5.9 NINTH FIVE YEAR PLAN (1997-2002)

As noted in the ninth plan, the future economic and social development of the country was in substantial measure reliant upon the technological improvements in agriculture. A massive application of science and technology would enable Indian agriculture to face the serious challenges of food security and ensure a place for value added Indian agricultural products in the global markets. The plan recognized the immense opportunities offered by technological revolutions in the field of molecular biology, biochemistry, physiology, Geographical Information System, systems analysis, revolution in informatics, remote sensing etc. The objective of the plan was

- To tap the potential of science and technology to improve the living conditions of the poor.

It was increasingly difficult to obtain any sizeable incremental production from the conventional Green Revolution areas. The concept of a second Green Revolution came during this period. For the second Green Revolution, it was necessary to make the grey areas green i.e., to make the unproductive areas productive. Hence, a major support for the rainfed areas, especially in Eastern and arid peninsular India would be necessary. Public sector research and technology missions (as for instance the mission on oilseeds) on various crops would play a crucial role in improving the crop production. The plan emphasized on how to reduce the yield gap between the lab and the field, particularly in the case of dryland crops which is an important challenge for agricultural research & technologies.

3.5.10 TENTH FIVE YEAR PLAN (2002-2007)

The agricultural development was a core element of the Tenth Plan, since growth in this sector was likely to lead to the widest spread of benefits especially to the rural poor. As cited in the plan, the first generation of reforms concentrated on the industrial economy. Reorganizations in the agricultural sector were neglected. Hence, this must change in the Tenth Plan.

One of the areas that needed attention was the development and dissemination of agricultural technologies. Over the years India has developed an extensive system of agricultural research centres and extension services. There was reason to believe, however, that the quality of the agricultural research efforts has weakened while the extension system has virtually collapsed. Strengthening of the agricultural research and development system, with special emphasis on bio-technology, and a significant improvement in the degree of sophistication in the technology dissemination methods were found to be essential to achieve rapid and sustained growth in agricultural productivity during the Tenth Five Year Plan. A radical renovation of the extension services was also the need of the time.

3.5.11 ELEVENTH FIVE YEAR PLAN (2007-2012)

The analysis by the Steering Group for the Eleventh Plan has identified technological change (using yield potential of varieties of major crops released by the National Agricultural Research System [NARS] as a proxy), public investment (including investment on irrigation), and diversification (represented by area under fruits and vegetables) as the most important proximate determinants of growth. The Eleventh Plan had found out some research gaps in the agricultural sector.

The following critical research gaps were identified in the Eleventh Plan:

- Integrating methods of traditional and modern biology giving attention to both yield and quality aspects.

- An orientation of public sector research in 'hybrid development with commercial viability' has to be reintroduced on a mission mode at least in crops like pigeon pea, soybean, and mustard.
- Indigenous plant types that inherently possess genes responsible for higher nutritive value (more protein, micronutrients, etc.) need to be identified and used for enriching nutrients in rainfed crops.
- A major research thrust is warranted in areas of balanced and site-specific nutrient supply and efficient water management strategies.
- Integrated Pest Management (IPM) needs greater emphasis.
- In horticulture, the research agenda needs to emphasize survey of indigenous biodiversity for resistance to various biotic and abiotic stresses for improvement in production, productivity, and quality of produce.
- In livestock, there is an urgent need to reorient research and assess the genetic potential of indigenous breeds. Intensive research work needs to be undertaken for genetic identification of traits of excellence in Indian breeds.
- With endemic shortage of animal feeds, research should explore technologies to augment feed resources, including genetic modification of microorganism to utilize high lignin forage grasses.
- With large quantities of animal products now being produced, research on process technologies, value addition, packaging, storage, transportation, and marketing should receive high priority. In the absence of a proper slaughter regime, there is considerable wastage and an effective package of practices for management of slaughterage needs to be evolved.

It was found to be essential to take a comprehensive view of the functioning of the agricultural research system and make systemic changes in the course of the Eleventh Plan.

CONCLUSIONS

Agricultural research in India has an interesting history regarding its growth and development. It started during the colonial era and today the agricultural research system in India includes some 27,500 scientists and more than 100000 supporting staff actively engaged in agricultural research, which makes it probably the largest research system in the world. They are distributed in the ICAR system, Agricultural Universities, General Universities and other organizations. In the present research system, the Indian Council of Agricultural Research (ICAR) at the National level mainly aids, promotes and coordinates research and education activities throughout the country. The research and education responsibilities at the state level rest with the State Agricultural Universities. In addition to these main streams of research, some general universities and other agencies like scientific organizations related to agriculture, Government

Departments, voluntary organizations, private institutions etc. participate in the nation's research efforts. Hence, the role of National Agricultural Research System in the development of agricultural research is of great importance within which all these organizations come. Five year plans play a major role regarding investment, technology transfer and other aspects related to agricultural development in India. Although agriculture has been playing the most vital role in Indian economy, during the course of the study, it has been found that not much emphasis has been given to the history of evolution of agricultural research in India.

ENDNOTE

¹ <http://planningcommission.nic.in/plans/planrel/fiveyr/1st/1stindex.html>

² <http://planningcommission.nic.in/plans/planrel/fiveyr/5th/5planch2.html>

³ <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>

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