

# History of agricultural research in India

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*India as a predominantly agricultural country attributes a major share of its overall development to the agriculture sector. Indian agriculture is a miscellaneous and extensive sector involving a large number of stakeholders. India has one of the largest and institutionally most complex agricultural research systems in the world. However, such a complex research system was not a sudden development. Instead, historically, it involved a process that started in the second half of the 19th century during the colonial period and eventually led to the establishment of the Imperial (now Indian) Council of Agricultural Research (ICAR). In the present research system, the role of ICAR at the national level in aiding, promoting and coordinating research and education activities across the country is of significant importance. In this article we trace the development of agricultural research system in India, since the colonial era till today. Various factors influencing the overall development of agricultural research system in the country are discussed. 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:** Colonial era, history of evolution, Indian agriculture, research system.

AGRICULTURE, as the backbone of Indian economy, plays the most crucial role in the socio-economic sphere of the country. Indian agriculture is a diverse and extensive sector involving a large number of stakeholders. 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. Moreover, since independence, India has observed considerable increase in the production of oilseeds (through the yellow revolution), milk (through the white revolution), fish (through the blue revolution), and fruits and vegetable (through the golden revolution). The role of the National Agricultural Research System (the NARS) was imperative in the context of all these momentous and successful upheavals.

The main events in the history of agricultural research in India can be grouped into the following seven categories<sup>1</sup>:

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 the Indian Council of Agricultural Research (ICAR).
7. The development of agricultural universities.

Among these, the first three signify the development of agriculture in the colonial India, whereas the next four were prominent in the post-colonial era.

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

## Agricultural research in colonial India

The early development of agricultural research in India was associated with the occurrence of famines. The recurrence of famines and starvation death of peasants in the second half of the 19th century opened the eyes of the imperial rulers. During this period 24 famines, big and

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small, took an estimated toll of more than 28 million souls<sup>2</sup>. However, at that time, little precedence was accorded to agricultural research and development in the country.

### *Establishment of agriculture departments and agriculture colleges*

A fundamental department of agriculture in India was started in the year 1871. Although the chief function of the department named 'Department of Revenue, Agriculture and Commerce' 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 significant. The credit 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. Primarily, the department was established by the Government with a view to supply cotton to the textile industries of Manchester, and not to feed the famine-ravished India. Actually, the inherent desire of the colonial rulers was to adjust the development of Indian agriculture to the economic necessities of British capitalism, which required India primarily as an agrarian colony for production of raw materials for British industries. This prevented the independent development of Indian agriculture, fulfilling the economic requirement of the Indian people.

Based on the reports of the Famine Commissions of 1880, 1898 and 1900, the Government of India (GoI) 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 on famine relief. In 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, in 1901, an Inspector General of Agriculture was appointed to advise the imperial and the provincial governments on agricultural matters. An imperial mycologist was appointed in the same year, and an entomologist was appointed in 1903. During the severe famines of 1899–1900, Lord Curzon, the then Viceroy of India, was convinced that the GoI must urgently concentrate on the agricultural sector to overcome the damages caused by frequent famines. As a consequence, Agriculture Research Institute (now the Indian Agricultural Research Institute (IARI)), together with a college for advanced agriculture training, was established at Pusa in the year 1905 and its director was the agriculture adviser to the GoI till 1929. Today, IARI is

one of the premier national institutes for agricultural research, education and extension in India. The growth of India's agriculture during the past more than 100 years, is closely linked with the researches done and technologies generated by the Institute. The Green Revolution stemmed from the fields of IARI. The Institute has been instrumental in the development of high-yielding varieties of all major crops in the country and taking major initiatives in integrated pest management and integrated soil–water–nutrient management practices.

The Agricultural School at Saidapet, Chennai, which was established as early as 1868, was later relocated to Coimbatore during 1906. Likewise, a branch for teaching agriculture in the College of Science at Pune (established in 1879) was subsequently developed into a separate College of Agriculture in 1907. Similar agricultural colleges were established at Kanpur, Sabour, Nagpur and Lyallpur, now in Pakistan, between 1901 and 1905.

Moreover, the agriculture departments in the provinces were expanded during the period when agricultural departments and colleges were started to be established. An All-India Board of Agriculture was established in 1905 with a view to bring the provincial governments more in touch with one another and making suitable recommendations to the GoI. The Indian Agriculture Service was constituted in 1906. However, the chief function of the agricultural colleges remained teaching, and training and research activities could not be carried out due to the lack of scientific and technical manpower and finance.

### *Establishment of the Imperial Council of Agricultural Research (the present-day ICAR)*

The Royal Commission on Agriculture (Linlithgow Commission), which was appointed in the year 1926, authoritatively reviewed the position of agriculture in India and reported the same in 1928. Having duly recognized the work done by the agriculture departments, the Commission stressed upon the enormous possibilities for future work and made comprehensive recommendations regarding the different problems of agriculture. The Commission proposed that an Imperial Council of Agricultural Research should be set up to endorse, direct and organize agricultural, including veterinary, research all over India. The Council was supposed to guide the research activities of central and provincial departments of agriculture. According to the proposal of the Royal Commission on Agriculture, the GoI, Department of Education, Health and Lands set-up the Imperial Council of Agricultural Research (now ICAR) on 16 July 1929.

### *The Commodity Committee*

Several semi-autonomous Central Commodity Committees were set up by the Ministry of Food and Agriculture.

These were concerned with research and development activities related to specific crops. 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 one to be established in 1921 on the recommendation of the Indian Cotton Committee (1917–18). The chief function of the Central Cotton Committee was cotton improvement with special focus on the development of improved methods of growing and marketing cotton. The Committee's support led to the development of 70 improved varieties and considerably improved fibre quality. 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 was 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 led to the setting up of commodity committees on crops such as lac, jute, sugarcane, tobacco, coconut, oilseeds, spices, cashewnut and arecanut. The Vice-President of ICAR presided over all the commodity committees. However, there was a great necessity to conduct 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 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 abolished in 1965 and the research institutes under their control were transferred to ICAR.

### *Plantation research in colonial India*

Though the experimental farms were established in 1884, the provincial agricultural departments could seldom go beyond the collection of revenue data and famine relief operations. For conducting experiments, the Government looked more to agricultural societies than to its own agencies. The Agricultural and Horticultural Society of India (AHSI) was established with specific objectives such as:

- 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.
- Evaluate the machines and processes for the extraction of fibres.

The official experimental farms were obsessed with cotton. Mounting pressure from British cotton tycoons had forced the GoI to initiate a vigorous cotton improvement programme. However, earlier projects of the 1840s and 1860s were not 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 gave 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 19th 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 600,000 lb of cotton. The Government's fascination towards imported technologies and ideas proved not to be advantageous. Instead, the dependence on traditional knowledge proved to be beneficial for the mills.

Sericulture remained a purely private concern for a long period of time. As for example, at the turn of the century Ms Tata and Sons successfully started a silk firm in Bangalore for the introduction of Japanese methods of sericulture.

Tea and indigo were the major items of export. In the 1870s, A. W. Blyth established a process by which it could be easily 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 brought out 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 19th century when Germany perfected its synthetic counterpart. In early 1899, the GoI 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, Bihar. Pusa was selected as the site because of its proximity to the plantations of north Bihar.

## Agricultural research in post-colonial India

Since independence, there has been a substantial growth in the Indian agricultural research system. ICAR is the chief public body at the national level for 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 foodgrains in the country.

The greater emphasis given to agricultural research could be established by the fact that the system guided by ICAR now has 49 ICAR institutes, 17 national research centres, 6 bureaus, 25 project directorates, 79 All-India Coordinated Research Projects (AICRPs) and the All India Network Projects (AINPs), 607 Krishi Vigyan Kendras (KVK), 52 State Agricultural Universities, 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 are

- About 23 traditional universities are carrying out agricultural research.
- Scientific organizations such as the Council of Scientific and Industrial Research (CSIR), and Bhabha Atomic Research Centre (BARC).
- Government departments such as the Department of Science and Technology and the Department of Biotechnology.
- Private and voluntary organizations.
- Scientific societies and institutions like the National Dairy Development Board which has been instrumental in transforming the dairy industry for rural development.

### 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 research work in different agro-climatic 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, 17 centres were established across the country to perform research on cotton (*Gossypium* species), castor (*Ricinus communis*), groundnut (*Arachis hypogaea*), taramira (*Eruca vesicaria*), jowar (*Sorghum bicolor*), bajra (*Pennisetum glaucum*), 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 with of full-fledged sections of plant breeding and genetics, agronomy, agricultural chemistry and soil science, plant pathology and entomology was established.

### Initiation of All-India Coordinated Research Projects

The conception of coordinated projects was first initiated for hybrid maize. It was under the United States Agency for International Development (USAID). The Rockefeller Foundation was the organization that was actively involved in crop improvement programmes in Mexico, Central America and the Caribbean. This organization was invited to assist in the maize improvement programme in India. The Ministry of Food and Agriculture under the GoI, signed an agreement with the Rockefeller Foundation in 1956, according to which the latter was to assist in the development of: (i) The postgraduate school of IARI, New Delhi, and (ii) Research programmes on the improvement of some crops (maize, jowar and bajra, initially).

Two leading scientists who were associated with the 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 ICAR and 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 1961. Encouraged by the success of the maize project, in 1965 ICAR decided to initiate coordinated projects on other crops as well as in other areas of research, e.g. animal husbandry, soil sciences, etc. Seventy coordinated projects on various subjects were launched within 3 years of this decision and these accounted for 40% 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 were elevated to the level of Project Directorates and some projects were changed to Coordinated Programmes. As a result, the number of coordinated projects decreased to 49 in the Fifth Five-Year Plan.

### Reorganization of ICAR

In 1963, the Ministry of Food and Agriculture appointed the Agricultural Review Team headed by Marion W. Parker of USDA (United States Department of Agricul-

ture), 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 1966 and 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 IARI, National Dairy Research Institute and Indian Veterinary Institute were made National Institutes. Eventually, a policy was formulated suggesting that an agricultural scientist would be appointed as the chief executive of ICAR with the designation of Director General. Accordingly, 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 GoI appointed a committee headed by P. B. Gajendragadkar (retired Chief Justice of India) to review the enrollment and 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 according to 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 of 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 was 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 was divided into eight agroecological zones and regional committees were set up for each zone. The function of these regional committees was to review the status of agricultural research and education in the concerned regions. The Governing Body of ICAR was to be assisted by a Norms and Accreditation Committee, which also looks after the development of agricultural universities and the grant of fellowships.

The mandates of the ICAR are as follows:

- To plan, undertake, aid, promote and coordinate education, research and its application in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.
- To act as a clearing house of research and general information relating to agriculture, animal husbandry, home science and allied sciences, and fisheries through its publications and information system; and instituting and promoting transfer of technology programmes.
- To provide, undertake and promote consultancy services in the fields of education, research, training and dissemination of information in agriculture, agroforestry, animal husbandry, fisheries, home science and allied sciences.
- To look into the problems relating to broader areas of rural development concerning agriculture, including postharvest technology by developing cooperative programmes with other organizations such as the Indian Council of Social Science Research, CSIR, BARC and the universities.
- To perform other tasks considered necessary to attain the objectives of the society.

#### *Development of agricultural universities*

The very fact that in 1948, there were only 17 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. Before the establishment of agricultural universities, teaching and research in agricultural sciences were largely conducted by these agricultural colleges which are attached to general universities. 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.

One of the important and premier institutes of the pre-independence era was the Imperial Agricultural Research Institute established at Pusa in 1905. Eventually, IARI has become one of the premier institutes for agricultural research, education and extension in the country. It has significantly contributed to the development of agricultural science with relation to the society and was instrumental in the Green Revolution. Its contributions include first-rate research activities, generation of appropriate technologies and development of human resources.

During the years 1948–49, the University Education Commission headed by S. Radhakrishnan, suggested that the country should focus on the establishment of rural universities. H. S. Singh and A. N. Jha (Chief Secretary and Development Commissioner, Uttar Pradesh (UP)) visited Land-Grant Universities of United States in 1950

and after coming back, advised the then Chief Minister of UP, Pandit Govind Ballabh Pant, to set up such a university in the state. 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 UP (Tarai), West Bengal (Haringhatta), Bihar (Patna), Odisha (Bhubaneswar), Travancore-Cochin and Mumbai (Anand, now in Gujarat) to be apposite for starting such universities.

In 1956, a blueprint for agricultural universities was prepared and this provided the root for the proposal by the Government of UP to the Central Government (in September 1956) for starting an agricultural university near Rudrapur in the Tarai region of UP. The Central Government also agreed to the proposal on an experimental basis. In 1959, the second Joint Indo-American Team was setup, which 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 interdisciplinary teaching programme; and should integrate teaching, research and extension. By 1961, there were demands from many states for agricultural universities and the GoI accepted the organization of a few more agricultural universities during the Third Five-Year Plan. Accordingly, the GoI appointed a committee, headed by 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 and 1965, seven agricultural universities were established in UP, Odisha, Rajasthan, Punjab, Andhra Pradesh, Madhya Pradesh and Karnataka. USAID contributed significantly to the development of agricultural universities through the Land-Grant Universities of United States. USAID provided assistance in the form of training of Indian scientists in USA, stationing of US scientists for teaching and research in Indian agriculture universities and by providing a limited amount of equipment for teaching and research.

One of the important schema came when the Education Commission (1964–66), headed by 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 M. S. Randhawa, made many useful recommendations for the development

of agricultural universities. It noted that the quality of leadership and 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 the NARS, the State Agricultural Universities are major cohorts in growth and 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 a 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 fulfil 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. centres of excellence, higher education in new areas, 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 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 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.

## Conclusions

Agricultural research in India has an interesting history regarding its growth and development. It started during the colonial era and today India boasts of an agricultural research system which includes some 49 ICAR institutions along with a number of national research centres, bureaus, project directorates, AICRPs, KVKs, State and Central Agricultural Universities where 27,500 scientists and more than 100,000 supporting staff are actively engaged in agricultural research. This makes the Indian agricultural research system probably the largest in the world. At present, ICAR plays a central role at the national level and it 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 (private seed companies, poultry farms), etc. participate in the nation's research efforts. Hence, the role of the NARS 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. In fact, the place assigned to agriculture in the Five-Year Plans after independence can be best judged from allocation to this sector in each plan. The outlay on agriculture has been rising steeply during the successive plans. It rose from Rs 601 crore in the First-Five Year Plan to Rs 50,924 crore in the 11th Plan (2007–12). Although agriculture has been playing the most decisive role in Indian economy, during the course of the study, it has been observed that not much emphasis has been given to the evolution of agricultural research in India, which has an incredible history of development. It is necessary to track the historical development of agricultural research in India, which will help in forecasting the future of Indian agriculture.

### Further readings

1. Bhatia, C. R., Review of the book 'Revitalizing Higher Agricultural Education in India: Journey Towards Excellence' by P. M. Tamboli and Y. L. Nene, Published by Asian Agri-History Foundation. *Curr. Sci.*, 2011, **101**, 1378.
2. Chandy, K. T., Agricultural Research and Education in India. Booklet No. 435, Agricultural Extension Education: AEES-4, 2002; Available at [www.inseda.org/...%20Agriculture%20and%20Environment%20Edu...](http://www.inseda.org/...%20Agriculture%20and%20Environment%20Edu...) (accessed on 29 August 2012).
3. Deepak Kumar, *Science and the Raj*, Oxford University Press, 2000.
4. Hortona, D. and Ronald, M., Using evaluation to enhance institutional learning and change: recent experiences with agricultural research and development. *Agric. Syst.*, 2005, **78**, 127–142.
5. Mruthyunjaya and Ranjitha, P., The Indian agricultural research system: structure, current policy issues, and future orientation. *World Develop.*, 1998, **26**, 1089–1101.
6. Maredia, M. K. and Raitzer, D. A., Review and analysis of documented patterns of agricultural research impacts in Southeast Asia. *Agric. Syst.*, 2012, **106**, 46–58.
7. Rajeswari, S., Agricultural research effort: conceptual clarity and measurement. *World Develop.*, 1995, **23**, 617–635.
8. Macload, R. and Kumar, D., *Technology and the Raj*, Sage Publication India Pvt Ltd, 1995.
9. <http://www.icar.org.in/> (accessed on 4 August 2012).
10. <http://www.iari.res.in/> (accessed on 12 August 2012).
11. <http://www.nddb.org/English/Pages/default.aspx> (accessed on 7 August 2012).
12. <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html> (accessed on 19 August 2012).
13. <http://www.icar.org.in/en/mandate.htm>

1. Singh, B. D., Organisation for crop improvement in India. In *Plant Breeding: Principles and Methods*, Kalyani Publishers, Ludhiana, 2001, pp. 801–830.
2. Majumdar, R. C., *An Advanced History of India*, Macmillan & Co Ltd, 1958, p. 944.

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