CHAPTER IV

Modern Agricultural Research in India

The basis of all agricultural progress is experiment. ... In spite of the marked progress which has been made in many directions during the last quarter of a century, it is hardly an exaggeration to say that agricultural research in this country is still in its infancy.1

- Royal Commission on Agriculture in India Report, 1928

The cases where influence of agricultural research has been felt are largely those in which industry has so directly impinged on agriculture that the technical demands of industry could impress themselves on agricultural practice... Crops in which an organized industry does not take a direct interest do not fare so well, though improved varieties of wheat and rice are coming into general use.2

-The Report of the University Education Commission (December 1948-August 1949)

Perhaps, to understand better the story proper in this chapter, it would be beneficial to take a bird’s eye view of Indian agriculture and related activities on the eve of the period of our study, because these, in turn, are related to the theme of our study. As stated in the previous chapter, Dr. J.A. Voelcker’s Report on the Improvement of Indian Agriculture (1893) was indeed the first serious endeavour to frame a policy of agricultural research suited to the conditions of India. However, the year 1929 marked a new stage in the history of agricultural development in India when the Imperial Council of Agricultural Research (ICAR)3 was established on the recommendation of the Royal Commission on Agriculture in India (1926) of which Lord Linlithgow was the Chairman. Already much spadework had been done but a new impetus was needed in the field of collation and co-ordination besides initiation of new lines of work. The central agency for collation and co-ordination for agricultural research during the period of our study was the ICAR. According to the Royal Commission, the constitution and functions of an Imperial Council of Agricultural Research were for promotion, guidance and co-ordination of agricultural research as well as control of veterinary research, training of research workers, a clearing house of information, a publication bureau, a meeting place of experts.

1 Royal Commission on Agriculture in India Report, 1928, (Reprinted 1983), Agricole Publishing Academy, New Delhi, 513.


3 Formally registered on 16 July 1929 under the Registration of Societies Act XXI of 1860. Renamed Indian Council of Agricultural Research w.e.f June 10, 1947, Mohinder Singh, Learned Societies and Institutions in India, Activities and Publications, Metropolitan Book Co. Private Limited, Delhi, 1975, 156.
Its most important duty would be to promote, guide and co-ordinate agricultural research throughout India, and to link it with agricultural research in other parts of the British Empire and in foreign countries. It would not exercise any administrative control over the Imperial Agricultural Department or provincial research institutions. Such control would remain, as at present, with the Imperial or provincial departments of agriculture. But it would be a body to which those departments could look for guidance in all matters connected with research and to which such research programmes as they might choose would be submitted for criticism and approval. Research programmes were formerly submitted to the Board of Agriculture for criticism but the practice has been discontinued as the Board did not feel itself in a position to perform this function satisfactorily. It would further be a body to which the Imperial and provincial governments could, if necessary, turn for advice as to whether their research work is proceeding on sound lines and is of such a standard that it commands respect and justifies the expenditure incurred on it. Until it came into being in 1929, the research work on agriculture, although of a high order, was mainly limited to the fields of agricultural chemistry and botany in so far as the provinces were concerned as shown in the previous chapter. Work in plant pathology, insect pests and bacteriological aspects were restricted to Pusa, Coimbatore and Poona. Important food and cash crops were naturally the main subjects of attention by the earlier botanists and plant breeders. For example, in Bengal and Madras, rice formed the main subject whereas in the Punjab and the United Provinces wheat absorbed most of the energies. Crops like jute, sugarcane, etc., also received attention. At Pusa improved wheat was first produced and tobacco and linseed were also bred. Pioneer work on physical, chemical and biological problems as well as studies on crop fungi and insect pests led to notable results. In the rice growing provinces many useful varieties were produced notably by Hector in Bengal, Parnell in Madras and Bhide in Bombay. Wheat breeding was carried out at Pusa by Howards, in the Punjab by D. Milne and his successors, by Leake in United Provinces, later on in Bombay by Chibber, Bhide and Kadam and also in the Central Provinces by the local workers. The ICAR provided the much-needed impetus. As noted above, its objects were to serve as the central agency for co-operation, collation and co-ordination for agricultural research in the country on the agricultural and animal husbandry sides; to finance schemes in accordance with well-planned programme of research in the provinces and States; and to fill up important lacunae in the work of the provinces and States Departments (as well as in universities and other institutions) in the

sciences basic to agriculture. Soon after the ICAR decided to bring under its purview schemes designed to test the results of research in the fields of cultivators. No scheme was considered as complete until the results obtained in laboratories and research stations were tested and found practicable and economical under conditions of farming prevalent in India. Similarly, modern organised research in animal husbandry in India commenced in 1889 with the opening of the Imperial Veterinary Research Institute (IVRI)\(^5\), Izatnagar, U.P. to investigate the diseases of animals. Adaptive research was immediately directed towards the control of contagious diseases and, especially, to the production of biological products to be used towards that end. Practically all the more serious diseases were eventually studied and diagnostic agents, as well as protective and curative vaccination for the majority, were evolved but rinderpest being the most important one received special attention and was the subject of original work, as a result of which ante rinderpest serum was first issued for use in the field in 1899. This was followed by the improved serum-simultaneous method, and finally by the cheap and efficacious attenuated goat tissue vaccine, which brought the elimination of rinderpest from India within the field of practical consideration. Up to the establishment of ICAR, the position was that research on disease had been well maintained, but it was confined almost exclusively to IVRI and opportunities throughout the provinces were neglected. Research on nutrition had commenced at a few stations, but was inadequate in volume; research in breeding was carried out by empirical methods and no real progress was made; research on sheep, goats and poultry was almost entirely neglected.\(^6\)

According to a statement prepared for the period 1934-35 for presentation to Parliament, the total area of India as computed for purposes of agricultural survey, based on *Agricultural Statistics of India, 1933-34*, was 1,162 million acres, some 668 millions of these being British India. Land not available for cultivation, i.e., barren, unculturable or covered by water, roads and buildings, amounted to nearly 145 million acres, while slightly more than 89 million acres were under forest. Of the remainder, culturable waste

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\(^5\) A premier research institute in the Continent and one of the oldest in India; awarded the status of Deemed University on 16 November 1983.

(i.e., lands which had never been cultivated or had been abandoned) accounted for 154 ¼ million acres and fallows for another 52 1/3 million. The net area sown with crops in British India in 1934-35 was nearly 227 million acres (about 5 million acres less than in the previous year), of which 50 ½ million acres were irrigated. If lands that carried more than one crop during the year were taken as separate areas, the total area sown was 259 million acres, a decrease of 8 million acres from 1933-34. Food crops occupied 213 million acres and other crops 46 ½ million acres. Food grains (i.e., cereals and pulses) took up 201 million acres, or 78 per cent of the sown area, and other food crops (including sugar, spices, fruits and vegetables), 12 million acres or 5 per cent of the total. Of the non-food crops, oilseeds occupied nearly 14 ½ million acres and fibre crops 17 ½ million acres. Rice being the most important single crop in India, the area under rice in 1934-35 was 82 million acres and the yield, 30,261,000 tons, or about one million acres and half a million tons less than in the previous year. Exports of rice and paddy amounted to 1,607,000 tons. As India proper habitually consumes more rice than she produces, it was again necessary to draw on other countries for supplies. During 1934-35, imports of rice and paddy from Burma amounted to 1,978,000 tons and 222,000 tons respectively; and from foreign countries to 282,000 tons and 112,000 tons respectively. Schemes of research on rice financed by the Imperial Council of Agricultural Research but administered by the local Departments of Agriculture were in progress in all the important rice-growing provinces. For example, critical tests of selected varieties of rice were continued in Bengal and several foreign types were introduced from Spain, Italy, America and north India. In Bihar and Orissa attempts to break the “dormancy” in the seed of several varieties of paddy by means of chemical treatment met with some success. During the same period, the area under wheat was 34 ½ million acres and the estimated production, 9,725,000 tons, compared with 36 million acres and 9,424,000 tons in 1933-34. Decreases in area occurred principally in the Punjab (from 11,292,000 acres to 10,483,000 acres) and the United Provinces (from 8,580,000 acres to 7,671,000 acres). In spite of the fall in area in the Punjab, the yield there increased by 245,000 tons. In the United Provinces the yield in 1934-35 was practically the same as in the previous year despite the reduction in acreage. In the Punjab, the established Punjab 8A lost its pre-eminence to a new species (C. 518) and many thousand of acres in the province were
sown with the latter. Another new wheat (C. 591) proved equal in yielding power to Punjab 8A and was grown on a commercial scale in several centres in the province. Extensive tests on several varieties of wheat carried out in Sind showed that under local conditions Punjab 8A was the heaviest yielder; but Pusa 114 seemed the most suitable type for those conditions. It was decidedly superior in quality to other varieties and proved more resistant to rust than the Sind and Punjab wheats. The major part of Barley was grown in the United Provinces, and the rest in Bihar and Punjab. This crop had a special value as a potential cash crop, as it was used for malting, and good malting varieties were always sold to brewers at a premium but was neglected before the advent of the ICAR. Some investigations on pulses were also carried out spasmodically, and various oilseeds received a fair amount of attention. There was an Oilseeds Specialist in Madras who evolved high yielding castor and did a botanical classification of some. Burns and Masur did also selection work on castor in Bombay as far back as 1922. Prior to World War I, large quantities of Italian potatoes were imported for seed purposes in Bombay and Sind. The War led Mann and his associates to investigate into the methods of storing potato seed and into the question of protection against storage rot and storage insects.  

In 1935 a scientific review of ICAR’s activities was carried out by two eminent scientists from Great Britain, viz. Dr. N.C. Wright, Director, Hannah Dairy Research Institute, Ayrshire (Scotland) and Sir John Russel, Director, Rothamstead Experimental Station, Harpenden, Herts (England). In 1946, Dr. Alexander B. Stewart of the Macaulay Institute for Soil Research, Aberdeen, was invited to review the position in India in respect of soil fertility investigations in general and manuring in particular and to suggest the steps which might be taken in order to obtain in as short a time as possible, adequate information under different conditions of soil and climate, to enable Agricultural Departments to give sound advice to cultivators, with the primary object of increasing the yields of crops in India. In implementation of the recommendations made in the report, the Council prepared a model scheme and the provincial Governments were asked to submit their schemes. In 1948, a Research Reorganisation Committee was constituted by

7 India in 1934-35, A statement prepared for presentation to Parliament in accordance with the requirements of the 26th Section of the Government of India Act (5 & 6 Geo. V. Chap.61), Anmol Publications, Delhi, Reprint, 1985, 1-18.
the Council to review the work so far done in all the schemes in progress and to suggest
the lines of future research. During 1950-51, in addition to the Council's current research
schemes aggregating 241 (120 on the agricultural side, 87 on the animal husbandry side
and 34 under miscellaneous headings), 45 new schemes (28 on the agricultural side, 10
on the animal husbandry side and 7 under miscellaneous headings) were sanctioned at a
total cost of Rs. 19.86 lakhs. In the same year, a comprehensive scheme for the
establishment of an Extension Service on an all-India basis was drawn up in consultations
with the various states for bridging the gap between the results of research and the
practices followed by cultivators. Set up in 1952, the Agricultural Extension
Organization by 1956-57 organised 47 Extension Training Centres all over the country.
By the end of 1956, 1,896 supervisory staff and 15,217 Village Level Workers completed
training and another 169 supervisory staff and 4,755 Village Level Workers were under
training. Out of Basic Agricultural Schools/Wings sanctioned, 59 were functioning.
These institutions had turned out 7,133 trainees and 4,220 were under training. All this
was done to cope with the increased demand for trained personnel for implementation of
NES Scheme under the Second Five Year Plan. The All-India Key Village Scheme
initiated in 1951-52 for the all round improvement in the productive efficiency of cattle
showed considerable progress during the year 1956-57. Against the target of 150
Artificial Insemination Centres and 600 Key Village Units proposed under the First Plan
period, 146 Artificial Insemination Centres and 545 Key Village Units were established
by March 1956.

Indian Agricultural Research Institute (IARI)

At the beginning of the twentieth century, a proposal emanated from the Government of
Bengal to utilize a large Government estate at Pusa in the Darbhanga district of Bihar as a
provincial agricultural research station and college. The Government of India concurred
in this proposal and took over the place for the establishment of an agricultural research
institute, an experimental farm and an agricultural college. Henry Phipps of Chicago,
USA donated 30,000 pounds to the Viceroy, Lord Curzon. It was intended that the farm
should serve as a model for similar institutions in the provinces. Thus was established the

8 Annexure No. 6, Vide answer to * Q. No. 294 Re: Investigations Made to ascertain the State and
10 Report 1956-57, Ministry of Food & Agriculture (Department of Agriculture).
Agricultural Institute at Pusa fully equipped with laboratories, museums, herbaria, library
and lecture rooms. In 1915, the Institute staff consisted of a Director (who was also
Agricultural Advisor to the Government of India), an agricultural chemist, a mycologist,
an economic botanist, an agricultural bacteriologist, an economic entomologist, a
pathological entomologist and an agriculturist who was in-charge of the farm. The
Institute moved to its present premises in New Delhi after the 1934 earthquake in Bihar.
A stimulus both to imperial and provincial agricultural development was provided, when,
in the financial statement of 1905-06, it was announced that a sum of Rs. 2 million
(subsequently raised to Rs. 2.4 million) would be available annually for the improvement
of agriculture. With this annual grant, it was contemplated to establish in each important
province, an agricultural college and research station. To direct the work, civilian
directors were appointed in all the larger provinces. However, the expansion of the staff
was not as rapid as anticipated. To meet this need, agricultural colleges were established
at Poona, Kanpur, Sabour, Nagpur, Lyallpur and Coimbatore. The First World War
slowed agricultural research and improvement. A considerable number of agricultural
officers entered the army or its attached services in one capacity or another. At the end of
the war, recruiting of agricultural officers restarted. The period from 1919 to 1929 was
one of considerable progress.11 Researches at the Indian Agricultural Research Institute
(IARI) and their results capable of direct practical application to the Intensive Cultivation
Programme leading to the production of more food during the period of our study
included the evolution of rust resistant strains of wheat and linseed, wilt-resistant rahar;
the discovery of a species of sataria useful for fodder purposes; the discovery that some
diseases of citrus are due to deficiency of trace elements and that these can be readily
corrected by sprays, etc.; the designing of a double or twin plough which enabled a single
pair of bullocks to double their usual output of work; the working out of measures for the
control of certain important pests of sugarcane; the working out of a suitable method of
controlling barley smut; the demonstration that rouging of potato crops and use of clean
seed appreciably increase the yield of potatoes; and the finding that phosphatic manuring
of berseem improves soil fertility, enabling succeeding crops of wheat to be grown

11 O.P. Jaggi, History of Science, Technology and Medicine in India, Vol. IX, Science in Modern India,
Atma Ram & Sons, Delhi, 2000, 46.
without further manuring. The IARI is a deemed university since 1956. From 1923 to 1958, the institute organised a two-year post-graduate diploma course leading to award of the Associateship. Reviewing agricultural education in India in the half century before its appointment, the Radhakrishnan Commission noted that 'some official attention has been given to agriculture, a number of developments have provided the beginnings of agricultural programme and policy. Twenty-one institutions for higher educational work in agriculture have been established'. Some of them were: Balwant Rajput College, Agra (1941); College of Agriculture, Banaras Hindu University, Varanasi (1945); Agricultural College and Research Institute, Hebbal, Bangalore (1946); Indian Dairy Research Institute (Post-graduate work, 1944), Bangalore; Indian Agricultural Research Institute, New Pusa, New Delhi (Post-graduate work; established at Pusa, Bihar in 1903, shifted to New Pusa, Delhi in 1936); Government Agricultural College (First degree and post-graduate work, 1906), Kanpur; Indian Veterinary Research Institute (Poona 1890; transferred to Mukteswar 1893; Izatnagar Branch 1913; Post-graduate work); Bihar Agricultural College, Sabour, Bhagalpur, (1945), etc. A number of new centres of higher learning were established in independent India, e.g. the Tata Institute of Fundamental Research, (1948) Mumbai, the National Chemical Laboratory, Poona (January 3, 1950), the Central Food Technological Research Institute, Mysore (October 1950), etc. The last mentioned engaged in research work on importance of tubers in cereal diets, synthetic grains, analysis of new foods for their nutritive value, and such other unfamiliar foods with the view to standardize the conditions for the production of a fortified product out of low grade food materials like tapioca which are naturally deficient in protein. All these centres of higher learning were engaged, in their own ways, in production of knowledge,

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12 Annexure No. 29 Vide Answer to * Q. No. 1754 Re. Researches at the Indian Agricultural Research Institute by Ch. Ranbir Singh, Statement I on Researches at the Indian Agricultural Research Institute, leading to the production of more food placed on the Table of the House on 17.4.1950 by the Minister of Food and Agriculture Shri Jairamdas Doulatram, Parliamentary Debates (hereafter PD), 1593.
15 Though started with the munificence of the Tata Trust in June 1945, the Government of India entered the picture in 1948 by reconstituting the governing body.
16 Annexure No. 6, Vide Answer to * Q. No. 1181(a) Re. Results of Research work undertaken in the Central Food Technological Research Institute, Mysore, Appendix VI to the House of the People Debates (hereafter HOPD), First Session, 16-26 May 1952, 421.
17 Annexure No. 32, Vide Answer to * Q. No. 125 Re. Statement regarding production of synthetic rice at the Central Food Technological Research Institute, Mysore, Appendix I to Lok Sabha Debates (hereafter LSD), 18.7.56, Thirteenth Session, 1956, 50.
linked to the knowledge demands of the times, and, what Sir J. C. Bose said about the Bose Research Institute (founded November 30, 1917), in 'fuller investigations of the ever-opening problems of nascent science which includes both Life and Non-Life.' His own institute of course was engaged also in investigations of different aspects of plant life, with a view to the discovery of the fundamental unity in life processes underlying the diversity of their manifestations in plants and animals.18

Commodity Committees

Apart from the ICAR, there were a number of Commodity Committees that dealt with research in respect of particular crops. The Commodity Committees were semi-autonomous bodies financed by grants from the Government of India, or by income from cesses, and were located in the main growing regions of the crops concerned. The earliest commodity committee to be organised was the Indian Central Cotton Committee established in 1921 in Bombay. This committee provided great stimulus to research on cotton and a number of improved varieties of cotton were evolved in different States with the aid of funds provided by it. The advantages of commodity approach to research were early seen. It enabled the research workers and agricultural administrators to concentrate on problems of a particular crop whether these related to plant breeding, physiology, agronomy, plant protection, economics or technology. Realising the benefits of commodity approach to research, commodity committees were organised in respect of a number of other commodities. Thus the Indian Lac Cess Committee was established in 1931 at Ranchi, the Indian Central Jute Committee in 1936 at Calcutta, the Indian Central Sugarcane Committee in 1941 at New Delhi, in 1945 the Indian Central Tobacco Committee at Madras and the Indian Central Coconut Committee at Ernakulam, Kerala were established, the Indian Central Oilseeds Committee at Hyderabad in 1947, and the Indian Central Arecanut Committee in 1949 at Kozhikode, Kerala. With the organisation of a series of commodity committees, the field of ICAR came to be limited to food crops such as wheat, rice, barley, maize, millets and pulses, tuber crops, grasses and fodder crops, spices, horticulture and problems common to various commodities such as control of plant diseases and pests, manurial trials, improved implements and dry farming in the field of agriculture, and investigation and control of animal diseases, animal nutrition,

18 Handbook of Indian Universities, Inter-University Board India, Association of Indian Universities, 1938, 1948 & 1958.
animal breeding and dairying in the field of animal husbandry.\textsuperscript{19} By 1957, there were 564 research stations financed and run by the State Governments. Out of these 483 were agricultural research stations, and 81 animal husbandry research stations. Agricultural research stations were 86 per cent, and animal husbandry research stations 14 per cent of the total.\textsuperscript{20} Nevertheless, as partly quoted at the head of this chapter, the Radhakrishnan Commission (Dec. 1948-Aug. 1949) observed in its report:

\textit{The cases where influence of agricultural research has been felt are largely those in which industry has so directly impinged on agriculture that the technical demands of industry could impress themselves on agricultural practice. The Indian Central Cotton Committee, organized by the government and financed to the extent of 18 lakhs a year by a tax on cotton, is such a case. It has operated since 1923, and has impressed its standards upon cotton farmers. Similar committees, similarly financed, have been organized for jute, sugar, lac, coconut, tobacco, oilseeds, coffee, tea and rubber. It is reported that about 80 per cent of the sugar-cane grown and about 50 per cent of the jute are raised from improved seed, since the manufacturers are able to influence farm practice. Crops in which an organized industry does not take a direct interest do not fare so well, though improved varieties of wheat and rice are coming into general use.}\textsuperscript{21}

\textbf{Training of Research Workers}

Even though the training of research workers, under a scheme of research scholarships or other ways, was one of the objects with which the ICAR was established, it was the view of the Advisory Board and the Governing Body, having regard to the number of scholarships given by other organisations for higher training abroad, that the Council’s funds were to be devoted to the undertaking of actual research. It was, however, arranged for higher training abroad from time to time in the following special branches of science: - Poultry diseases and husbandry, Dairy technology, Soil microbiology, virus diseases of plants, Cytology, Physiology of fruit trees, Insect pests, Agricultural biometrics, Soil chemistry, Gas storage of fruits, Tobacco problems, Horticulture, Animal genetics, Bacteriology (Veterinary). It also made a grant to the Calcutta University for special postgraduate training in statistics.\textsuperscript{22} To intensify research in scientific agriculture, steps were taken to increase the supply of technical personnel trained in agricultural sciences by the grant of over-seas scholarships; and other measures were taken to increase the facilities

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\textsuperscript{19} M.S. Randhawa, \textit{Agricultural Research in India, Institutes and Organisation}, ICAR, New Delhi, 1958, iii-iv.
\textsuperscript{20} Ibid. 281.
\textsuperscript{21} \textit{The Report of the University Education Commission} (December 1948-August 1949), Volume I, 181.
\textsuperscript{22} A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op. cit.
\end{flushleft}
available for the prosecution of agricultural research and development.\textsuperscript{23} For example, some 80 students were sent to the USA for training in agriculture, including Animal Husbandry by early 1947.\textsuperscript{24} The number of M.Sc.s and doctorates turned out from the agricultural colleges in India during 1946-47 was 74. Also, 156 candidates received postgraduate diplomas in agriculture, veterinary, forests, dairying, and allied sciences in the same year. According to the Report of the Scientific Manpower Committee in 1948, it was estimated that facilities for training in post-graduate research work in agricultural sciences were available in India for only 166 students. There were no facilities worth the name for training in soil survey or soil conservation.\textsuperscript{25} By the following year a number of scholars, nominated by the Central and Provincial Governments, were sent abroad for training in various subjects such as agriculture and allied subjects, dairy, animal husbandry, fisheries, zoology, forestry, soil conservation, poultry, horticulture and veterinary. The first batch of 15 Indian farmers was sent to Australia in 1955 to see for themselves the modern agricultural practices in vogue there.\textsuperscript{26} The shortage of field workers all over the country was acute. The position compared very unfavourably with other countries. This shortage affected the production of food in the country. However, Government of India was alive to the responsibility of training more workers for the field and implementing schemes for increasing the right type of men for applying the results of research in actual practice.\textsuperscript{27} Therefore Rural Development Programmes (Extension of Service) were launched under which training centres were set up for the purpose of training village level workers required for manning the Development and Community Projects. The activities covered, besides others, agricultural and allied fields for reclamation of available virgin and waste land, provision of water for agriculture through irrigation canals, tube-wells, surface wells, tanks, lift irrigation from rivers, lakes and pools, etc., provision of quality seeds, improved agricultural technique, veterinary aid,

\textsuperscript{23} Reply by Dr. Rajendra Prasad, Minister of Agriculture to * Q. No. 183 Re. Research in Scientific Agriculture by Dr. P. S. Deshmukh, CAILD, 20.11.1947, 328.
\textsuperscript{24} Secretary of the Agriculture Department Sir Pheroze Kharegat in reply to * Q. No. 781 Re. Advanced Studies in Agriculture in USA for Indian Students by Seth Govind Das, LAD, 10.3.1947, 1587.
\textsuperscript{26} Annexure No. 13, Vide Answer to Q. No. 730 (b), Statement regarding the first batch of 15 Indian farmers sent to Australia in 1955, Appendix to LSD, 16.8.56, Thirteenth Session, 1956, 696.
\textsuperscript{27} Response of Minister of Agriculture Shri Jairandas Doulatram to * Q. No. 270 Re. Agriculture Researches for Improving Production and Farmer's Economy by Shri Damodar Swarup Seth, CAILD, 13.2.1948, 645-46.
improved agricultural implements, breeding centres for animal husbandry, development of fruit and vegetable cultivation, soil research and provision of manures, etc. These Projects also organised Land Armies consisting of ex-Army men who were trained as Land Army Commanders in these activities and assigned to agricultural colleges and schools to organise extension work. The Central and the State Governments took steps from time to time for the co-ordination of Agricultural research, extension and education; but these measures were intensified in the light of the Community Projects and National Extension Work for dissemination of scientific information to the farmers. Production of extension literature and visual aids was stepped up and the States provided facilities for processing and publishing in regional languages such information for the benefit of farmers and village level workers. Agricultural research stations in many places used neighbouring villages as laboratory to make their work more realistic in regard to practical problems of the farmers. ICAR sponsored a number of refresher courses in different States for the sons of farmers. Training classes were arranged both at the Centre and in the States to train the officers of the State Governments in scientific methods of storage. Co-operative working arrangements between 5 selected land grant colleges in the USA and Indian agricultural/veterinary research and educational institutions were established to bring about co-ordination between agricultural research, extension and education. Training classes were conducted in the States to train information personnel in the collection, processing and publishing of scientific data and information literature.

**Trend of Agricultural Research in India**

During much of the twenty years of our study, the report of the Royal Commission on Agriculture largely stood as a guide for almost any aspect of Indian agriculture, while the labours of the I.C.A.R. in fostering and co-ordinating research over a period of years made available detailed and authoritative information on the technique of agricultural improvement for application by the provinces on which rested the responsibility of

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28 Annexure No. 21, *Vide Answer to Q. No. 504 (b) and (c) Re. Rural Development Programme (Extension of Service)*, Appendix III to HOPD, First Session, 16-26 May 1952, 186-7.

29 Annexure No. 3 *Statement showing steps taken for co-ordination between agricultural research effecting extension and education and also for collection of data of research done by various states, Vide Answer to Q. No. 787, Appendix V to LSD, 19.3.56, Twelfth Session, 1956, 421.*
carrying through schemes of agricultural development. In order to judge the degree of progress achieved in researches in agriculture during the two decades under our study, it will be convenient to take up improvements in respect of some food crops, only as indicative and illustrative of the attention given, with a view to augment both the quantity and quality of the food (cereal) resources of India. We will also look at other sectors of agriculture related researches in viz. cattle breeding and disease, manures and fertilizers, agricultural implements and tools, agricultural meteorology, irrigation, pest control, floods, soil conservation, etc., as reflected in the debates in the central legislature.

Rice

Since in the field of crop production, rice occupies the foremost place in India, the I.C.A.R. gave a great impetus by subsidising a chain of research schemes related to it at Bankura, Suri, Chinsurah, Berhampur, Cuttack, Kanke, Nagina, Raipur, Habiganj, etc. The schemes terminated on the 31st March 1944. In addition to these, minor schemes were started in Travancore, Kashmir and Baroda in 1940-41 and in Bombay in 1946. The results were of immense value to the cultivators. The practical and theoretical knowledge that emerged from these activities spread to other areas, where benefits in productivity manifested themselves.

1. Breeding - In parts of Bihar and Central Provinces wild rice formed a weed encroaching widely on the cultivated rice. A purple-pigmented rice was evolved whereby the wild rice could be easily distinguished and weeded out at the early stages. This was adopted in practice and led to a saving of 20 lakhs maunds of paddy in the Chattisgarh Division alone, whereas the cost of research was about a lakh of rupees. In Bihar, the purple-pigmented varieties gave higher yield viz. 26 to 28 maunds per acre; higher-yielding flood-resistant varieties for Bihar, higher yielding flood and drought-resistant varieties for Bengal, higher yielding flood, drought and salinity-resistant varieties for Orissa and higher yielding deep water varieties for Bihar and Assam were obtained and distributed. In the United Provinces one-tenth of the area under early rice was liable to the attack of Gundhi insect pest. Six hybrids resistant to this insect were evolved. These proved to be a great boon to the cultivators and helped in increasing the production of

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Sir Jogendra Singh, Member for Education, Health and Lands on the Means whereby the present prosperous Agricultural Conditions might be used for the Permanent Rehabilitation of Agriculture in India, LAD, 10.3.1943, Vol. I, 10 February -10 March 1943, 956.
paddy in U.P. Other high yielding strains too were obtained, selected and distributed to
the cultivators; in Kashmir crosses between early-maturing, disease resistant Russian
varieties and typical Kashmir strains produced high-yielding disease resistant hybrids that
also required less water. Vernalisation also gave promising results. Cultivators were keen
to adopt the superior strains.

II. Cultural and manurial side - On the cultural and manurial side, the co-ordinated
schemes were conducted in Bengal, United Provinces, Bihar, Central Provinces and
Berar, Assam and Orissa up to 31st March 1944. The object was to develop suitable
improved schedules of manuring and cultivation in respect of different varieties of the
crop and soil-climates. Definite results of practical and economic value to the cultivators
were obtained as a result of the investigations.

At Chinsurah in Bengal, ammonium sulphate at 20 lbs. Nitrogen gave an increase of 12
per cent. grain and 23 per cent. straw. At double this rate the increase was 22.5 per cent.
grain and 49 per cent. straw. Oil cake at 40 lbs nitrogen gave higher yield but further
higher application only increased straw and not grain. Green manure also gave increased
yield. At Bankura also increased yield was obtained with ammonium sulphate. In Bihar
heavy manuring was not found advisable. The general application of artificial manure
was found economically sound and the best time was thirty days after transplanting. Both
dhaincha and sunn hemp proved efficient green manure and peas, khesari and gram could
be used as catch crop without affecting rice crop. In the United Provinces at Nagina Rice
Research station green manuring with sanai gave the highest yield at the lowest cost as
compared to organic and inorganic manure. Molasses also gave higher yield. In the
Central Provinces 1:1 nitrogen and phosphate gave highest yield and largest net profit. In
Assam broadcasting of aman (deep water) gave higher yield over transplanting; in the
case of boro double transplanting gave 65 per cent. increase. The local agricultural
departments everywhere were expected to take all necessary steps to introduce the
improved practices.31

The agricultural departments in India have devoted much
time and attention to work on green manure crops with a
view to discovering the crops which can best be used for

31 A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture
side, op.cit.
green manure, the time at which they should be grown and the manner in which they should be applied. Their work has shown that satum hemp on the whole gives the best results and it would doubtless be more often grown for use as green manure were it not that it may exhaust so much of the moisture in the soil that, when it is ploughed in, there is not sufficient left both to decompose it and to enable a second crop to grow.32

III. Fungus and virus diseases – The three major diseases of rice in India were Foot Rot (Fusarium), Blast (piricularia) and Helminthosporium. Since 1943, the Indian Council of Agricultural Research financed a scheme for investigations on the first two diseases in the Madras Presidency, and in Sind, Helminthosporium disease was the subject of study.33

Foot Rot – It was found that the disease was mainly seed borne and it could be controlled by treatment of seed with organomercury compounds like Ceresan, Agrosan GN and Atiran at the rate of one gram of fungicide per one lb. of seed. The efficiency of seed treatment was demonstrated to the cultivators by organising large-scale demonstration in a few places and the method became very popular. It cost only four annas to treat the seed necessary to plant an acre. The Directorate of Plant Protection in the Ministry of Agriculture advocated and popularised large-scale pre-treatment of seeds with mercurial compounds.34

Blast – The problem had been tackled in Madras since a long time through the cooperation of the Policy Specialist and the Mycologist at the Coimbatore Research Institute. With the then available knowledge of the disease, a hybridization programme was put through between susceptible and resistant varieties. Several new strains were obtained of which Co. 15, Co. 16, Co. 25 and Co. 26 may be mentioned. While the first two were resistant, the other two were practically immune to the disease, and were found, by trial in cultivators’ fields to be suitable for distribution in the districts of Tanjore, Tiruchirapalli and Mathurai by the Madras Agricultural Department. A yield of 3,000 to 3,500 lbs. per acre was obtained from these strains. Work on collecting more information

33 A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, ibid.
34 Annexure No. 7, Vide Answer to * Q. No. 125, Reg. Researches made for evolving disease-free seeds of wheat and paddy, Appendices IV to VI to the CAILD, Sixth Session, November-December 1949, 153-154.
of the disease and breeding new immune varieties was intensified in Madras through a grant by the ICAR. Valuable information on the pathogenecity of the fungus, alternate hosts, physiological forms, etc. was obtained. On the breeding side, a range of immune types was evolved. Madras was the only province where this disease was studied intensively with a view to evolving resistant types. “All the resistant varieties produced in Madras would be useful for rice tracts in that province only. The need for the rest of India will be tackled on an all-India basis at the Central Rice Research Institute which has come into existence only two years ago.”

*Helminthosporium* – This was prevalent largely in the North East and Eastern rice tracts of India, though it occurred sporadically here and there causing inequitable loss, during certain seasons it occurred in epidemic form and caused enormous damage as it did in Bengal in 1942-43. The application of agrosan G and sulphur was found effective in the latter. These investigations were helpful in initiating control measures and thus increasing the yield of rice. On the fundamental side of research, the mycological division of the Central Rice Research Institute, Cuttack concentrated its attention to the study of the two diseases, *piricularia* and *helminthosporium*. As a first step, the extensive collections of all improved varieties of India and some of the foreign types, about 500 in numbers, were tested for their reaction to the two diseases. Suitable special techniques for infecting the varieties artificially and for grading the degree of infection produced were developed. These varieties were classified into susceptible, moderately resistant, resistant and immune groups.

IV. *Insect pests of rice* - In the case of *Gundhi* insect pest in U.P. resistant strains were evolved as stated above. In C.P. *Gangai* insect pest were studied and control measures adopted. In Bengal rice Hispa and rice stem borers were studied.

As a result of these researches, there was a marked progress in the evolution of high yielding, drought, disease, flood and salinity resistant strains. By careful breeding, varieties were obtained which roughly yielded 10 to 25 per cent more than the local types. Experiments on the economics of manure showed marked effect and an economic

36 Ibid.
37 Ibid.
return. As a matter of fact, at the all-India level proper manuring produced increased yield varying from 20 to 150 per cent., and taking India as a whole an average increase of 30 per cent. was well within the range of practical achievement. The problem of water requirements of rice was another question, the successful solution of which was of the greatest importance. Such studies were undertaken usefully in the Punjab, showing 'how economies can be effected in the use of water without detriment to the yield'.\textsuperscript{38} Results of some of the researches of immediate practical value obtained at the Central Rice Research Institute, Cuttack, in 1950 indicated the following: that field trials brought to light some early maturing and high-yielding Chinese varieties, which were superior to the local varieties. Seeds of these varieties were supplied to various rice-growing States and some of them gave good performances in West Bengal, Bihar and Madhya Pradesh even under adverse climatic conditions; that application of ammonium sulphate in dry condition of soil, two to three weeks before transplanting, gave an increased yield, of about 100lbs. per acre over the yield by the customary method of applying the fertiliser in puddled condition either at transplanting or soon after; that experimental results indicated that the application of the basal dose of organic manure (e.g., compost or F.Y.M.) and top dressing of the inorganic fertiliser gave the maximum yield response. The application of 4 tons of compost per acre, supplemented by 100 lbs. of ammonium sulphate gave an increase of about 626 lbs. of paddy per acre over the basic yield of 2,152 lbs. per acre; that pre-treatment of the seed with nutrient solution at a small nominal cost increased the yield by about 10 per cent; that the possibilities of growing two crops of rice per year on the same land under canal irrigated conditions in Orissa were demonstrated; the optimum time for raising the second crop and the varieties suitable for such a practice were worked out and demonstrated on the cultivator's fields; the relative status of all improved varieties of rice in India with regard to their resistance or susceptibility to the above mentioned two important and most prevalent diseases, \textit{Helminthosporium} and \textit{piricularia}; that in some of the rice varieties which rapidly lose their viability when stored, particularly through the humid monsoon period, the loss in viability could be checked by treating the seed with chemicals before storing; that new parasites to control

\textsuperscript{38} \textit{A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side}, op.cit.
crop infestation by stem borer were obtained and breeding those parasites on a large scale to test them out in field conditions was tried; the source of infection by insect pests of stored grain was determined; techniques were evolved and tested to estimate the loss to crop by the attack of pests and diseases. Rice still held pride of place in the Council's researches when India gained independence.

Japanese Method of Rice Farming

A method of intensive rice farming, known as the Japanese method and which the Kora Gramudyog Kendra of the Bombay Suburban District Village Industries Association at village Shampavalli near Borivli had been carrying on evoked considerable interest during the period of our study particularly when it was reported that following this method over 6,000 lbs. of paddy per acre was obtained at the Agricultural School Farm at Kosbad against the average yield of about 650 lbs. per acre for the whole of the Bombay State. Similar high yields were obtained at other places also in the State by the adoption of the method. The Gandhi Smarak Nidhi gave a grant of 9 lakhs of rupees to the Kora Gramudyog Kendra for the popularisation and propagation of this improved paddy farming. Considerable interest was evoked on this subject, and a large number of questions on the various aspects of the problem, such as its technique, economics, etc. were asked in the Parliament necessitating a statement touching at least the salient points of this farming practice. The fundamentals of Japanese Rice economy were intensive cultivation, with improved cropping and cultivational practices. For example, most of the lowland (long duration) rice was always transplanted; healthy seedlings were grown in raised nurseries using low seed rate, transplanting these in rows and that too in limited numbers in a bunch, adequate interculture and weeding, heavy manuring both the nursery and the crop with organic manures and fertilizer. In a broadcast from the All India Radio on January 10, 1953, the Minister for Agriculture, Dr. Panjabrao Deshmukh focussed the attention of all interested in better rice cultivation on this improved method of rice cultivation and appealed to the State Governments, Co-operative Organisations and public bodies and workers to lend a helping hand in achieving stepped-up rice production in India by adopting the Japanese method wherever possible with suitable regional and

39 Annexure No. 29, Vide Answer to * Q. No. 2021 (a), Appendices X-XXXIII to PD, Third Session, 2nd Part, 1950-51, 1070.
local adjustments in the technique, if necessary, particularly in the great rice growing
regions of the country. The broadcast aroused a great deal of enthusiasm and a number of
enquiries were received about the details of the method. Encouraged by the response, the
Minister for Agriculture convened a meeting in New Delhi to consider the ways and
means of starting a country-wide campaign for the promotion of the method so that in the
following rice growing season it was adopted over vast areas resulting in greater
production of rice. The representatives of Kora Kendra also attended the meeting, which
came to the conclusion that in view of the success achieved in Bombay the time had
arrived for its large-scale adoption in the country and that while experts could go on
finding further facts about the method, its economics and possible improvements in the
same, there were certain features in this rice farming technique (such as substantial
economy in seed material, manner of raising seedlings and method of transplanting them)
which were distinctly advantageous and also capable of immediate large-scale adoption.
For the wide promotion of the Japanese method a countrywide campaign started on 15th
March 1953, when the Minister for Agriculture requested the Prime Minister and all the
State Ministers to open the campaign by broadcast from different centres of the All India
Radio.41 The total acreage of land brought under Japanese method of paddy cultivation
during 1954 and 1955 was 13, 19,548.79 and 8, 13,954 acres respectively,42 and 19,
88,837.25 acres during 1955-56.43 It is interesting to note here that given Mahatma
Gandhi's preference to manual labour, the Village Industries Association started by him
propagated 'in favour of the consumption of hand pounded rice because its nutritive
value had been considered to be higher than that of milled rice'.44

Wheat
I. Breeding - In Wheat the most intriguing problem was that of rust. Therefore, after the

41 Annexure No. 31 A note on the measures proposed to be taken by the Ministry of Food and Agriculture
to Propagate the Japanese method of Rice Cultivation, Vide Answer to * Q. No. 142(c), Appendix I to
HOPD, Third Session, 1953, 54-7.
42 Annexure No. 65, Statement giving the total acreage of land brought under Japanese method of paddy
cultivation during 1954 and 1955. State-wise, Vide Answer to Q. No. 275 (a), Appendix III to LSD,
43 Annexure No. 15, Statement showing the total area State-wise brought so far under 'Japanese method'
of rice cultivation during 1955-56, Vide Answer to Q. No. 30 (a), Appendix I to LSD, 17.7.56, Thirteenth
Session, 1956, 29.
44 Prof. N.G. Ranga in the course of the debate on * Q. No. 1800 Re. Bringing of the Results of Agricultural
Investigations and Experiments to the Notice of the Masses by Mr. Ram Narayan Singh. LAD, 5.12.1938,
3820.
establishment of I.C.A.R., the most important work in this line was the breeding of rust-resistant varieties of which Dr. K.C. Mehta of Agra University conducted investigations with very promising results. The Council also financed a scheme for breeding rust-resistant wheat in the hills with stronger stem and higher yield. This was of great importance as the hill wheat was mainly responsible for infecting the plains wheat with rust. All the wheat growing provinces had now a fair range of improved varieties and were widely adopted by the cultivators.

II. Cultural and manurial side - As in the case of rice, the results of careful and manurial experiments on wheat resulted in definite value to the cultivators. For example, under irrigated conditions, in the Punjab, green manure gave 15 per cent. higher return under the rotation of wheat, toria and cotton. With wheat following wheat, the increase was 32 per cent. In some places the best green manure was guara, in others sann. Calcium Cyanamide at 1 or 1 ½ maunds per acre gave an increase of 21, 41 and 63 per cent. respectively. Sodium nitrate at 2 ½, 3 and 5 maunds per acre gave an increase of 13, 17 and 39 per cent. respectively. Ammonium sulphate at 1, 3 and 4 maunds per acre gave 6, 8 and 24 per cent increase. Under barani or unirrigated condition green manure gave increased return but they were not uniform. Manuring with ammonium sulphate or superphosphate without irrigation was found profitable. In some trials manuring definitely required lesser number of irrigations. In the United Provinces, well-made compost was found equal to cattle dung and 20 lbs. of nitrogen and 20 lbs. of phosphate gave 80 per cent. increase in Rohilkhand and Kumaun circle. At Kalianpur 200 maunds of farmyard manure or compost gave 17 per cent increase and Hardoi green manure with “sanai” gave a 15 per cent increase of wheat. In the Central Provinces, under irrigated condition cattle dung was the only effective and profitable manure. Powdered cake (200 to 400 lbs.) applied before sowing or ammonium sulphate at 80 to 100 lbs. drilled in with the seed also gave effective result. Profitable yield could be maintained by steady manuring at the rate of 3 to 4 tons per acre, adequate rotation with leguminous crop and deeper primary tillage. The experiments on dry farming showed that if water supply was adequate a manured plot gave a higher proportion of dry matter for the same amount of water supplied.

III. Fungus and virus diseases - Under the cereal rust scheme (Agra College),
Physiologic races of rust prevalent in the country were studied. These physiologic races resembled one another in external characters but differed in the wheat varieties or strains that they attacked. At Simla the botanical and agronomical characters of a large number of hill wheat were examined and the hybridisation between the best indigenous and rust-resistant varieties was completed. It was possible to breed varieties of wheat which were fairly resistant to the prevailing one or other three types of rust (black, red or yellow) and such wheat were in great demand by the cultivators; in the Bombay rust scheme, the variety Kenya Governor was first found resistant but developed heavy infection of another physiologic race (race 21) to which it was susceptible. The magnitude of loss due to rust ravages varied from 5 to 100 per cent. The work was thus of direct benefit to the cultivators; a scheme on rust was also in operation in the Central Provinces. The investigation on rust led to the conclusion that the persistence of rust from year to year was not due to the barbery plant but to the over summering of the disease on self-sown and early-sown wheat in hill areas throughout India, hence the special importance of breeding a rust-resistant hill wheat referred to before. The Luthra Method involving rouging out affected plants and application of hot water treatment to seeds before sowing dealt with the loose smut attack on wheat. Milling and baking qualities and protein survey of wheat was done at Lyallpur and samples grown there from other areas were tested with the objectives to ascertain the protein content of different kinds of wheat; loss of vitamin B in different processes of milling; and the extent to which the nutritive value of wheat flour could be increased by mixing with it flour of different pulses, without reducing its palatability. "These studies are therefore helpful in improving the nutrition of people, (large bulk of whom are vegetarians), and in advising the growers to grow the kinds of wheat rich in protein and vitamin content." Certain definite results of practical value were obtained and steps taken to publicise them. In order to intensify the work, a Wheat Rust Control Committee was set up by the Government of India in October 1947 to look into the matter deeply and guide, conduct and co-ordinate all research work in the country connected directly or indirectly with wheat rust on all-India basis.46

45 A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op.cit.
46 Annexure No.7 to * Q. No. 125 Re. Researches made for evolving Disease-free Seeds of Wheat and Paddy, Appendices IV to VI to the CAILD, Sixth Session, November-December 1949, 153-154.
Government tried as far as possible to supply the best variety of wheat, the Punjab Wheat called c591, which on the whole withstood the rust pest, though that variety was not enough for all the regions. As recommended by the specialist Dr. K.C. Mehta, the cultivation of wheat in summer months and on hill areas was prohibited, as the specialists said that if summer wheat was prohibited, there was less chance of the disease spreading. The wheat rust characteristically did not start where it actually appeared. "It is said that these germs proceed along the direction of the wind or breeze and travel thousands of miles. This is what the scientists tell us." It was proposed under the scheme that a mixture of three varieties of each resistant to one of the three rusts would be distributed to the cultivators for sowing, so that in any given year when any one of the rusts attacked the crop, the whole crop would not be destroyed. In this way, enough of seed would be saved during the following season. With regard to India the difficulty was that there were three varieties or types of rust, as detailed above, which attacked wheat. The numbers actually went into hundreds but there were three main varieties and because Indian wheat was subject to attack by all these three varieties, therefore a seed that was resistant to all the three varieties had to be discovered.

Barley

Under a scheme of the I.C.A.R., the malting and brewing qualities of barley were tested. Of the 118 samples from the 1939 crop, 16 were selected for test at the Imperial Institute of Brewing, London. One variety viz. C. 251 was found to be of grade I quality comparably with choice California for which some brewers were prepared to pay a premium. The susceptibility of Barley to rust attack (black and yellow) was under investigation of Dr. Mehta as in the case of wheat. Consequent upon the abolition of prohibition in U.S.A., Barley was considered a potential cash crop, as California barley was not likely to reach Britain as before. Moreover, barley had an advantage over wheat in as much as it could stand better unfavourable weather conditions and could be grown

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47 Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 1282 Re. Loss of Foodgrains due to Locust-Pests and Rust by Shri V.C. Kesava Rao, CAILD, 22.3.1949, 1741-43.
48 Annexure No.7 to * Q. No. 125 Re. Researches made for evolving Disease-free Seeds of Wheat and Paddy, op. cit.
49 A note on the results of research work carried out on insect pests and plant diseases under different Central organisations placed on the Table of the Constituent Assembly of India (Legislative) by Minister of Agriculture Shri Jairamdas Doulatram in response to * Q. No. 956 Re. Research in Agricultural Pests and Plant Diseases by Pandit Mukut Bihari Lal Bhargava, 8.3.1949, 1344-50.
in poor soils.\textsuperscript{50}

\textbf{The Millets: Jowar, Bajra and Ragi}

These three crops occupied nearly 40 million acres in British India and 63 million acres in the whole of India. Jowar was the most important, Bajra came next and Ragi third. Jowar and Bajra were main grain suppliers outside the rice and wheat zones. The dried stocks of jowar provided the main cattle feed over a large tract. Consequent upon researches on jowar cultivation, results suggested that in areas of scanty rainfall, dry farming methods could lead to an increase by 20 per cent; that jowar heads are liable to two or three kinds of fungus attack of which "grain smut" was most important; that this could be controlled by treating the seed with copper sulphate and still better by rubbing the seed in finely powdered sulphur; that the insect pest \textit{viz.} jowar-borer could be best tackled by digging out and burning the stubble and the jowar grass hopper by sweeping them in large open mouthed bags during the early stages; that ashes, sand dust, bhusa, neem leaves, etc., pucca underground pits were recommended for storing this grain. There was a scheme for investigating the chemistry of malting jowar grain with the object of ascertaining whether the grain could be converted into foods suitable for infants and invalids. The results obtained suggested that whereas previously it was considered impossible to preserve jowar malt flour for more than three months without deterioration, it was found that malt could be kept packed in vacuum tins without deterioration or loss of aroma for at least six months; that under higher humidity, the keeping quality of malt lowered during storage in containers which were not air-tight; that being cheap, jowar malt could be utilised in the preparation of biscuits, malt cakes and malt bread; that blending of malt meals for two or more chosen cereals might be used in the preparation of malted foods; that it could be preserved for long and the protein contents could be adjusted to any desired level of nutrition; and, that jowar malt could prove useful as a supplementary food for infants.\textsuperscript{51}

\textbf{Pulses and Oilseeds}

India is very rich in species and varieties where pulses are concerned. In April 1941, a co-ordinated scheme with the object of evolving high yielding, disease-free and drought-

\textsuperscript{50} A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op.cit.

\textsuperscript{51} Ibid.
resistant strains of pulses was taken up for operation in Madras, Bombay, Bengal, U.P.,
Bihar, C.P., N.W.F.P., Orissa, Sind, Hyderabad, Mysore, Gwalior and Baroda. In the
Punjab, a separate scheme on soya bean and another on gram wilt were in operation. The
pulse plants increased soil fertility; the grains were a source of nutrition to human, and
the grain and its bye-products to animal.\(^{52}\) In point of area oilseeds were next in
importance to rice and wheat. They were sources of oilcakes, the edible ones of which
were of great value as cattle feed, while all of them could be used as manure.
Traditionally various oilseeds received a fair amount of attention. During the period
under study, certain schemes were in operation such as Groundnut breeding (Madras);
Rape and mustard breeding (Punjab); Linseed and other oilseeds (C.P. & Berar); Castor
breeding (Hyderabad); Groundnut breeding (Mysore); Brassica and sesamum breeding
(Calcutta University); Coordinated scheme of research on pests and diseases of oilseeds
in Madras, the U.P., the Punjab, the C.P. & Berar and Hyderabad; Storage of groundnuts
(Madras); manurial experiments with groundnut cake (Hyderabad); Multiplication and
distribution of improved groundnuts (Madras) and multiplication and distribution of
improved linseed (U.P.). The Groundnut breeding scheme in Madras, the Rape and
Mustard scheme, Punjab and the Oilseed research scheme, C.P. expired on the 31\(^{st}\) March
1945 and the work of the two was taken over by the provincial Governments. High
yielding strains were evolved under these schemes. They were popularised among the
cultivators. Trials in the United Provinces with released castor strains from Hyderabad
showed that all of them were significantly superior to local strains. The Madras
groundnut storage trial showed that deterioration was more in summer than in winter.
Well-ventilated room with masonry walls and pucca flooring duly fumigated showed
marked reduction in insect activity. Significant results were obtained about the behaviour
of the different insects. A co-ordinated scheme of research on pests and diseases of
oilseeds was in progress at Madras (groundnut), U.P. (Til, etc.), Punjab (Rape and
mustard), C.P. (Linseed), and Hyderabad (Castor). In addition to these, some other
schemes such as storage of groundnut at Bharat Vanaspati Products Limited, Pachora,
East Khandesh to study the problem under factory conditions, research on linseed rust

\(^{52}\) Ibid.
under Dr. K.C. Mehta (Agra College), and research on insect pests of sunflower were
carried out. With the creation of the Indian Oilseeds Committee, the work relating to
oilseeds was taken over by them.\textsuperscript{53}

\textbf{Potatoes and Vegetables}

Researches on potatoes and vegetables, including breeding, manurial and cultural
operations, related fungus and virus diseases, insect pests, storage, etc. were also
conducted. Much of the work on potato was taken over by the Central Potato Research
Institute, Patna (April 1949) and its sub-stations. In 1942 the I.C.A.R. published a useful
bulletin on vegetable growing. The Second World War dislocated the supply of seeds of
European types of vegetables from the United Kingdom, U.S.A., etc. and the Council
financed schemes for the production of these vegetable seeds in Kashmir, Baluchistan,
Punjab, Saharanpur, etc. “The results obtained are promising and there are good reasons
to hope that India will be able to manage in future without imports of vegetable seeds
from abroad.” There were schemes for fruit and vegetable preservation also.\textsuperscript{54}

\textbf{Pests and Diseases of Crops}

The Government of India appreciated the need for research on pests and diseases of crops
as early as 1905 when they appointed an Entomologist and a Mycologist in the Imperial
Department of Agriculture. The Government had arrangements for research work on
agricultural pests and plant diseases at the IARI. Research was also carried out at various
institutions under schemes financed by ICAR and the Commodity Committee of Jute,
Cotton, Sugarcane, Lac, Tobacco, Coconut and Oilseeds.\textsuperscript{55} Since this research work is
primarily concerned with food crops, the results of some of the major researches related
to these have already been indicated above.

\textit{Locusts} - Following the recommendations of the Board of Agriculture in 1929, ICAR
organised a Locust Section and later in 1939 the entire organisation was taken over by the
Government of India under their direct control. The investigations led to detailed
information on the reproduction, migration and seasonal activities of the pest as well as

\textsuperscript{53} Ibid
\textsuperscript{54} Ibid
\textsuperscript{55} Reply by Minister of Agriculture Shri Jairamdas Doulatram in response to *Q. No. 956 \textit{Re. Research in
Agricultural Pests and Plant Diseases} by Pandit Mukut Bihari Lal Bhargava, CAILD, 8.3.1949, 1344-50.
the mechanical, biological and insecticidal control measures.\textsuperscript{56} As a result of the study made under the auspices of ICAR on the subject of locust from 1931-39, the Government of India to keep a watch on locust outbreaks established a skeleton locust-warning organisation. This organisation was substantially strengthened in 1942 after the outbreak of the locust cycle of 1940-46. It had field staff and scouts posted at strategic points in all the areas where locust was likely to breed. With the decline of locust activities in 1947, the co-ordinated locust control scheme was terminated but the Warning Organisation was continued in order to observe occasional appearance of locust and its breeding activity, and to issue warning to the Provinces and States likely to be affected thereby. These warning-staff were posted in Rajputana and the adjoining desert areas at suitable places and they constantly moved about for purposes of observation. The Locust Warning Organisation was also equipped to destroy the pest, should that appear in such numbers as to give rise to incipient swarms. Mainly this pest originated outside the borders of India, namely, in Pakistan, Iran, Arabia, and countries further west up to East Africa. The Government of India, therefore, kept in touch also with the anti-locust centre in London, which was in charge of the work in East Africa, Sudan, etc. Some damage was caused in Ajmer-Merwara by the locust during 1946-48.\textsuperscript{57} For locust control in India, the Locust Warning Organisation of the Government of India in existence since 1939 was expanded with the outbreak of the Locust cycle in 1951 and a control wing was added to it. The Central Anti-Locust Organisation, which was responsible for locust control in all the desert breeding areas in India, posted its staff at about 60 strategic points in the desert areas. They were equipped with the entire necessary locust fighting equipments, insecticides, vehicles, etc. With the help of the Central Anti-Locust Organisation, the States threatened with locust invasion built up their individual Anti-Locust Organisations for control work in the cultivated areas. The over-all co-ordination of locust control in India was the responsibility of the Director, Locust Control in India. With the assistance of the Government of United States of America aerial control of locusts was also tried out

\textsuperscript{56} A note on the results of research work carried out on insect pests and plant diseases under different Central organisations placed on the Table of the Constituent Assembly of India (Legislative) by Minister of Agriculture Shri Jairamdas Doulatram in response to * Q. No. 956 Re. Research in Agricultural Pests and Plant Diseases by Pandit Mukut Bihari Lal Bhargava, 8.3.1949, 1344-50.

\textsuperscript{57} Reply by Minister of Agriculture Shri Jairamdas Doulatram in response to * Q. No. 956 Re. Research in Agricultural Pests and Plant Diseases by Pandit Mukut Bihari Lal Bhargava, CAILD, 8.3.1949, 1344-50.
in Rajasthan. The Central Locust Organisation, which was responsible for control operations in the Scheduled desert areas in Rajasthan, Punjab, PEPSU, Bombay, Saurashtra and Kutch, were divided into three Circles, each in charge of an experienced Entomologist with Headquarters at Bikaner, Jodhpur and Palanpur. At other places that were important from the point of view of locust strategy, particularly along the Indo-Pakistan borders, there were outposts that were equipped with insecticides, hand and power dusting and spraying machines and motor transport. Many of the places were equipped with radio transmitting facilities for quick and timely action. The three Circles - Eastern, Central and Western with headquarters at Palanpur, Jodhpur and Bikaner respectively - were divided into 12 zones that were again sub-divided into locust outposts for the desert areas. There were 70 such outposts, including at Sikar, Neem-Ka-thana, Jhunjhunu, Khetri, Ganganagar, Pokran, Jaisalmer, Luni, Barmer, Bhuj, Jamnagar, Churu, Bikaner, etc. Phadka, a small winged locust, was first reported in Ajmer in 1946. Preliminary trials of control methods were made in 1947 and the Government of India sanctioned grants amounting to Rs. 8,700 during the year 1947-48 and Rs. 22,204 during the year 1948-49. Effective measures were applied with the available stock of insecticides and dusting machines over an area of about 3,000 bighas in 60 villages in 1948 and the crops were completely saved in this tract. The Local Administration worked the scheme and the Government of India provided technical guidance. But the area infected was very much larger and the total loss was estimated at 27 lakhs. The major difficulties in securing greater success were the lack of funds for purchasing insecticides and dusting machines, booking and transport difficulties and insufficient field staffs. For the year 1949-50 the Government of India had under consideration a proposal for the extension of the scheme at a cost of Rs. 93,000 to meet some of these difficulties. No accurate estimate was available of the loss caused to food grains by all kinds of pests and diseases. At the Pest Infestation Conference held under

58 Annexure No. 29, Vide Answer to Q. No. 56 (b), Measures taken to Combat damage caused to Crops, Appendices I to XII to PD, Fourth Session, August-September 1951, 130.
59 Annexure No. 17, Vide Answer to * Q. No. 479 (b) Re. The action taken to meet the threatened Locust menace, Appendix IV to HOPD, Third Session, 1953, 260.
60 Annexure No. 23, Vide Answer to * Q. No. 1066, Statement showing the number of Locust Centres in North-Western areas of the Country Sanctioned and set up, Appendix VI to LSD, 21.12.55, Eleventh Session, 1955, 626-7.
61 Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 957 Re. Control of Locust and Phadka by Pandit Mukut Bihari Lal Bhargava, CAILD, 8.3.1949, 1348-50.
the auspices of the F.A.O. in London in 1947, it was estimated that the over-all loss due
to infestation in stored food grains in the world, as a whole was about ten per cent. In
1946-47 the Ministry of Agriculture established a Plant Protection, Quarantine and
Storage Directorate not only to deal with locust but also with all pests and diseases. The
Directorate took the following steps to combat the damage caused by pests and diseases:
(i) Assisting the Provinces and States to set up adequate plant protection organisations in
their areas;
(ii) Assisting them in controlling outbreaks of pests and diseases on a large scale that was
beyond the resources at their command;
(iii) Procuring from abroad and distributing pesticides machinery to Provinces and States;
(iv) Giving to Provinces and States information and timely warnings about the outbreaks
of pests and diseases; and
(v) Preventing the entry of foreign pests and diseases that did not exist in India then.
During 1948-49, large scale operations were carried out against Rice Grasshopper in the
Bombay Province, against Phadka in Ajmer-Merwara, diseases such as smuts in Delhi
and Ajmer-Merwara by the method of seed treatment, mango and sugarcane pests in the
U.P., monkey pest in Orissa, against a variety of pests and grasshoppers in Madras, and
spraying operations for the control of blight in potato in West Bengal. 62
In all cases where major pests and Plant diseases threatened the food crops, the central
Directorate of Plant Protection, Quarantine and Storage rendered all possible assistance in
technical advice and machinery, insecticides, etc., to the states to fight the menace
successfully. Godowns were disinfected before storing grain; uniform stacks of bags were
built and were dusted by insecticide so as to prevent infestation and to retard infestation,
if any; if infested grain arrived or got subsequently infested, it was fumigated by Ethylene
dichloride carbon tetrachloride mixture. Fumigation was carried out in godowns if they
could be made airtight or under gas-proof covers; stocks were inspected every fortnight
and the grain categorised and issues ranged accordingly; and as far as was possible the
godowns were rat-proofed and methods such as cyanogassings and poison baiting were
adopted to destroy the rats. Training classes were arranged both at the Centre and in the

62 Reply of Minister of Agriculture Shri Jairamdas Doulatram to Q. No. 1282 Re. Loss of Foodgrains due
to Locust-Pests and Rust by Shri V. C. Kesava Rao, CAII.D, 22.3.1949, 1741-43.
States to train the officers of the State Governments in scientific methods of storage. Arrangements were also made for the ready availability of insecticides, fumigants and other equipment necessary for grain storage.\footnote{Annexure No. 29, Vide Answer to Q. No. 56 (b), \textit{Measures taken to Combat damage caused to Crops}, op. cit.}

**Cattle Breeding**

The importance of cattle to Indian agriculture cannot be overemphasised: "the cow and the working bullock bear on their patient backs the entire structure of Indian agriculture." During the period of this study, bullocks were almost the only motive power available for the cultivation, irrigation and carting of the produce to the market.\footnote{Enclosure No. 19, \textit{Vide Item No. 74, Key-Village for the Development of Cattle in India}, Appendix I-V to PD, Fifth Session, 1952, 329-32.} But there was deficiency of bullocks fit for agricultural operations in some parts of the country on account of inadequacy of modern transport facilities like road and railway transport. A part of the traffic went over to bullock carts and bullocks were diverted for the purpose of carrying freight where the prices and wages were high.\footnote{Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 550 \textit{Re. Protection of Cattle for Agriculture} by Shri Ram Sahai, CAILD, 28.8.1948, 605.} Therefore, cattle breeding under methods not thoroughly understood were being conducted at Government Farms in nearly every province and State when the ICAR came into existence. The improvement of established herds by what was thought to be method of breeding but which was probably to a large extent due to improved management was undertaken with considerable success. The milking capacity of Indian dairy breeds of cattle was gauged and development through progeny testing was done. Cross breeding with Fresiens produced a high yielding indigenous cow that was maintained under protected conditions.\footnote{\textit{A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side} op.cit.} The Royal Commission on Agriculture reviewed the state and condition of animal husbandry research in 1926. Since then full opportunities were taken to obtain opinion from distinguished foreign experts - Dr. Normal C. Wright from Great Britain (1936), Dr. Ralph Phillips and Dr. E.A. Tunnicliff from USA (1944), Dr. S. Cheng from China (1948) and Dr. K.V.L. Kestevan from FAO (1949) regarding the state and condition of research carried out at IVRI. They commented very favourably on the working of the institute. The suggestions made by Dr. Phillips and Dr. Tunnicliff on
cattle breeding and animal disease problems were communicated to all concerned for action wherever possible. The first Quinquennial All-India Cattle Census in India was held between December 1919 and April 1920; the fourth in 1935 related to British India, excluding Bengal, Bihar and Orissa. The total bovine population in this area rose to 113,283,973 in 1935 from 101,150,501 in 1920. The population of cattle, including buffaloes, based on 1940 livestock Census was 178.2 millions. According to 1945 census the cattle population in the provinces only was 111.2 millions; figures for states were not available. The improvement of cattle required attention on a number of complicated details that may be classified into details connected with (a) feeding, (b) disease control, (c) breeding, and (d) management, apart from education, propaganda, etc. The Animal Husbandry Departments of provinces were constituted for giving attention to all these matters. To improve the breed of cows and bulls in India after 15 August, 1947, the Government of India approved of the establishment of two Experimental Cattle Breeding Farms, one for evolving a general utility type of cattle at Jubblepore and another for a type with high milking capacity. An Expert Committee was also appointed to make recommendations for preserving the cattle wealth of the country and promoting its development. In view of the great diversity of conditions in India, twenty-nine breeds of cattle were recognised by the All-India Cattle Show Committee set up by the Central Government in 1938 (as against, for example, only 19 in Great Britain). ICAR paid special attention to the Sahiwal, Sindhi, Hariana, Gir, Kankrej and Ongole breeds of cattle and to the Murrah breed of buffaloes. The cattle maintained at Central Governments Farms were mostly milch breeds. Draught and dual-purpose cattle were maintained at Provincial Government Farms according to the requirements of particular localities. There were General utility cattle like Bhangari, Gaolao, Hariana, Hissar-Hansi, Kankrej, Krishnavalley, Lohani, etc.; draught variety like Alumbadi, Bacchaour, Dhanni,
Hallikar, Kangayam, etc.; and dairy variety like Deoni, Gir, Red Sindhi, Sahiwal, etc. The first scheme of modern research in breeding animals was goat breeding in the United Provinces in 1932. Sheep breeding in Bombay and the Punjab was initiated in 1935-36 and in Madras in the following year. During this time, the lack of trained animal geneticist had become very apparent and a student was sent abroad in 1938 and encouragement was given in the training of others. During the following year, sheep-breeding schemes involving crossing with foreign breeds were started in Mysore and Kashmir, and the first wool laboratory was instituted in Bombay. In this year also cattle herd book registration was commenced so that reliable records of the pedigree of the best stock in breeds of all-India importance should be available. As soon as the principles of genetics were applied, it was realised that progress in breeding depended upon an accurate appraisement of the value of the individual. There was no great difficulty in doing that as far as milk or beef was concerned, and milk recording societies were formed in 1938, but neither in India nor elsewhere, had a method of measuring the quality of the animals' ability to work been evolved. A scheme at Hissar was started in 1940 under a physiologist and geneticist to study the problem, and another was commenced in 1942 at Allahabad. In 1940 investigation in artificial insemination was commenced at the Indian Veterinary Research Institute, and for large field experimental application, four substations were opened in 1943. Again in 1940, it was considered that by using proper breeding methods, it would be possible to encourage milk production in cows belonging to draught breeds without impairing the quality of bullocks, and work towards that end was started in Madras, and another on different lines but with the same object commenced with the Kankrej breed in Bombay in 1942. In these years other schemes of scientific breeding of sheep and goats were initiated. Among them was one for the production of Karakul pelts in the North West Frontier Province, and for evolving a breed of goats by the use of purebred Angoras, which would produce mohair. New sheep breeding schemes for the improvement of wool were financed. In 1942 one of a different type was opened in NWFP. Its aim was to demonstrate the value of improved shearing, washing and grading of fleece. In 1944, a similar scheme was opened in Ajmer. Milk

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72 Reply of Member for Education, Health and Lands Mr. N. R. Sarkar to Q. No. 123 Re. Cattle Breeding Farms by Mr. Jamnadas M. Mehta, LAD, 14.1.1942, 1632-34.
recording or what were then called, Cattle Improvement Schemes were started in the villages of Travancore, Bombay, Sind, U.P., Punjab and Ajmer, the ultimate object being to turn selected villages into subsidiary cattle farms, and the immediate object to encourage villagers to increase their milk supply by controlled breeding from milk recorded stock with better feeding and management. Poultry breeding schemes commenced in Bombay in 1935 with the parallel study of improvement by selection and crossbreeding. In 1940, the Indian Veterinary Research Institute carried a poultry scheme to certain villages to see what the result of introducing foreign blood would be and to supplement the breeding experiment of foreign birds, which had been extensively carried out at the Institute. Work in Bengal, Central Provinces, Madras and Bombay was taken up later on similar lines. In appreciation of the research in cattle breeding, it may be noted that it was almost of necessity associated with the immediate production of improved sires for immediate use and, while the advantages of that procedure were apparent, it was not always realised that the fear of failure to turn out a continuous supply of good sires restricted bold experimentation. For instance, an experiment in crossbreeding might well result in the production of only one or two individuals of the new type required and a great number of comparatively useless one, and a farm might, therefore go out of production for a decade or two, although the eventual result might well justify the experiment. Research in sheep and goat breeding for the most part was devised on what were thought to be sound lines and was subjected to periodic review of geneticists. Its object in regard to sheep was almost invariably the production of more and finer wools and evidence of the ultimate success of the work was to be found in the interest taken in it by the shepherds of Bombay, Mysore, Kashmir and to a lesser extent in the Punjab. However, there was the tendency to ignore the possible danger of reducing the meat quality of sheep. The main immediate advantages accruing to the farmer from research in breeding were: the supply of improved sires and reliable breeding stock; the means of multiplying their usefulness by artificial insemination; the means of improving the quality and quantity of wool by selective or cross-breeding; and, the means of increasing the milk supply from goats by upgrading with superior indigenous breeds.\textsuperscript{73} By 1956, a

\textsuperscript{73} A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op.cit.
total of 144 artificial insemination centres for cows and buffaloes were opened under the all India Key Village Scheme.  

**Cattle Disease**

As already mentioned, up to the establishment of ICAR, research on cattle disease had been well maintained, but it was confined almost exclusively to I.V.R.I., though by 1937 there were five veterinary colleges in India, but they only imparted instruction up to what was called the Assistant Veterinary Surgeon’s stage. Higher instruction in the Veterinary Science was not provided for by any of these colleges. After the establishment of ICAR, the importance of obtaining provincial and state participation in research was early recognised and, as a first step, it was considered necessary to ascertain, as far as possible, what the actual diseases were which caused most loss and under what conditions they were encountered. For that purpose, Disease Investigation Officers were employed eventually in practically every province and major State, as well as Assistant Disease Investigation Officers, whose interest was either in poultry or sheep or goats. The first Disease Investigation Officer was posted in Hyderabad in 1933. A complete veterinary survey was made, some of the diseases of unknown origin were defined, their causes ascertained, and methods of overcoming them made available. Apart from that, these officers were a very useful link between cattle owners, provincial veterinary staff and research centres as a means of disseminating modern knowledge issuing from research centres. Their work was reviewed in 1945 when it was decided that, the survey having been finished, the officers should turn their attention to research on a few specific problems of particular importance in their localities; subjects were allotted to each to avoid overlapping. The nature of the benefit derived from the work of the Disease Investigation Officers can be gauged from the following instances: in Assam, the presence of an insidious fatal disease called Bovine pleuropneumonia was discovered; a protective vaccine was available and as it was considered that the disease could be stamped out before that spread to other provinces, a scheme to that end was financed. In Bengal, the production of Rinderpest Vaccine in a desiccated form was perfected and

74 Annexure No. 20, Vide Answer to Q. No. 376 (a), Statement Showing the Names of the Places where artificial Insemination centres for Cows and Buffaloes have been opened under the all India Key Village Scheme, Appendix IV to LSD, 2.8.56, Thirteenth Session, 1956, 350-52.

75 Response of Sir Girija Shankar Bajpai to * Q. No. 615 Re. Recruitment of Staff for the Proposed Central College for Veterinary Training by Mr. T. S. Avinashilingam Chettiar, LAD, 12.3.1937, 1767.
applied. In Orissa, the presence of Tuberculosis among municipal cattle of Puri, which threatened the health of the neighbouring cattle, was discovered, and a method of dealing with that devised. In Bihar, the cause of a devastating sheep disease called Pittoo or Giller was ascertained and methods made available for dealing with that. In the United Provinces, a simple method of vaccinating cattle by scarification was put under large-scale test that promised to simplify and cheapen the process. In Hyderabad, an excess of flourine was found in natural water in large areas that resulted in malnutrition of the cattle; means of reducing its effect were devised. Instances of more advances could be given for practically every province and State. Parasitism received early attention. The first Imperial Council of Agricultural Research scheme was started in 1934 in the Punjab and others followed in the United Provinces, Central Provinces and Madras. These were mainly directed towards the elucidation of the life history of common parasites so that methods of control could be framed. Progress was slow but methods of effectively treating bowel parasites were known and could be applied to the mass. Liver-fluke was of ever increasing importance as the irrigated area of the country expanded and, with that, ravages caused by the parasite. Field research proceeded concerning methods of control. Protozoology was taken up in 1935 and the scientist on the subject posted to the Indian Veterinary Research Institute. Under his direction many new drugs produced elsewhere were tried out in the experimental stage and passed on for field use, such as Plasmaquonine, Naganol and Antrypol. The studies were otherwise of fundamental nature with promise of producing practical results. Since 1938 attention was given to diseases likely to arise as a result of intensive dairying such as had caused great havoc in other countries, namely, Tuberculosis, Johnes Disease, Contagious abortion and Mastitis. Poultry diseases received special attention and the production in 1945 of a protective vaccine against the Ranikhet disease was a major triumph to the credit of IVRI. Methods of immunisation against Anthrax, Blackquarter, Contagious Bovine and Caprine pleuropneumonia, Fowl Pox, and Ranikhet disease were used extensively and were on the whole satisfactory. A suitable vaccine for Haemorrhagic septicaemia was also evolved. Protective vaccine against Foot and Mouth disease was on field trial. However, modern drugs for blood diseases like Surra and Paraplasmosis and for disease of the udder were neither easily obtained by the owner nor easily administered. In effect, research directed
towards the prevention of the diseases associated with intensive husbandry was encouraged all through our period of study.\textsuperscript{76}

**Indigenous drugs**

Perhaps, therefore, scientific study of indigenous drugs likely to be of therapeutic value in veterinary practice, investigation into the efficacy of indigenous systems of treatment of cattle in India and the collection of relevant literature to ascertain the utility and extent of actual use of Ayurvedic medicines for cattle was also in progress during this period.\textsuperscript{77}

Report of an enquiry made into the indigenous system of cattle treatment was received in November 1939. An article by the author of that report, incorporating the findings in the report was published under the title ‘Animal Husbandry in Ancient India’ in September-November, 1941 issues of the ‘Indian Farming’ published by ICAR.\textsuperscript{78} Besides this, an article entitled ‘A Short History of Ayurvedic Veterinary Literature’ by Leslie Hamilton Shirlaw was published in *The Indian Journal of Veterinary Science and Animal Husbandry* of March 1940. The ICAR also sanctioned a scheme for one year for collection of further information on the subject.\textsuperscript{79} The Provincial Governments, according to the local conditions, took measures for maintaining the standard health of their cattle. For example, in Madras the Veterinary Institutions and Touring Billets of the Animal Husbandry Department were responsible for maintaining the standard health of cattle in that province. The Veterinary Assistant Surgeons in charge of Veterinary Institutions attended to the treatment of non-contagious diseases and the Touring Veterinary Assistant Surgeons to the control and treatment of contagious diseases. The Touring Veterinary Assistant Surgeons also attended to non-contagious diseases during the course of their tours. There were 138 Institutions in the province on the 31\textsuperscript{st} March 1948 and 3, 23,947 animals were treated in these institutions during 1947-48. There were 165 Touring Billets on 31\textsuperscript{st} March 1948, each one manned by a Touring Veterinary Assistant Surgeon. Twenty-nine of these billets had stockman compounders to assist the Touring Veterinary

\textsuperscript{76} A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side op.cit.


\textsuperscript{78} Reply by Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 1353 Re. Enquiry into Indigenous System of Cattle Treatment by Prof. N. G. Ranga, CAILD, 9.4.1948, 3534-35.

\textsuperscript{79} Reply by Minister of Agriculture Shri Jairamdas Doulatram to Shri Biswanath Das’s Supplementary Question to * Q. No. 1353 Re. Enquiry into Indigenous System of Cattle Treatment by Prof. N. G. Ranga, CAD, 9.4.1948, 3534-35, Appendix I to CAILD, Sixth Session, November-December 1949, 6.
Assistant Surgeons in their work. During the year 1947-48, animals protected against common contagious diseases like Rinderpest, Haemorrhagic Septicaemia, Blackquarter, Anthrax, Sheep pox, Fowl pox, Fowl Cholera, and Ranikhet numbered 8, 25,997. The number of cases treated on tour in 1947-48 was 1, 12,928. Four mobile units were sanctioned to facilitate disease prevention work in the province. Similarly, in the United Provinces, the Biological Products Section functioned since the mid-forties to control contagious diseases of cattle. This section to meet the entire demand of the Province manufactured anti-Rinderpest and Haemorrhagic Septicaemia vaccines; others were purchased from the IVRI. By 1948, there were 206 Veterinary Hospitals in the Province. The number of in and out door patients treated in these institutions was 8, 22,138 during 1947-48 and medicines were supplied to 1, 02,585 cases not brought to the hospital. The total number of animals inoculated against various diseases during the year was 5, 94,922. With a view to study the nutritive value of cattle feed and fodder available in different parts of the Province and to evolve economically balanced rations for those areas, a cattle feeding research scheme was in operation at Bharai in Jhansi district. Cultivation of fodder crops especially leguminous crops that provided nutritious fodder and increased the fertility of the soil was encouraged. In Orissa, the Provincial Government took up schemes for the introduction of balanced rations and improvement of pastures. In Assam, vaccine and inoculation against contagious and infectious diseases was undertaken. There were forty-one veterinary dispensaries and four veterinary hospitals operating with 46 Veterinary Assistants and 130 Veterinary Field Assistants. There was one Veterinary College for training adequate number of qualified graduates. One Goat tissue vaccine Section was there to maintain cattle health. The bullock and other cattle remained as important as ever for Indian agriculture. Perhaps, therefore, the Central Council of Gosamvardhana was constituted in January, 1952 with the objects to advise, co-ordinate and assist the State and Regional Gaushala Federations in matters relating to the development of Gaushalas and Pinjrapoles on proper lines; encourage the establishment of Key Village Centres for the breeding of cattle on scientific lines and starting of Gosadans for bovine cattle and diffuse useful scientific knowledge on animal

80 Reply by Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 950 Re. Education to Farmers in Rearing Cattle by Shri Moturi Satyanarayana, CAILD, 8.3.1949, 1333-34.
husbandry throughout India; take steps for the prevention and eradication of infectious and contagious diseases affecting the life and health of bovine cattle, and also take adequate steps for preservation of cattle in times of famine and other emergent situations, etc.\textsuperscript{81}

**Key Village**

The Key Village Model Scheme aimed at bringing about progressive improvement in the milking and working efficiency of the vast millions of India's cattle population. This was done by the establishment of a network of 150 All India Centres and 600 cattle improvement areas called key villages, throughout the country. These 'Key Villages' were to be compact areas selected for the purpose and were to contain about 500 cows/she-buffaloes over 3 years of age. All the existing bulls in the area were to be removed and replaced by superior bulls produced in cattle breeding farms or elsewhere and their breeding was to be strictly controlled. The area was to be properly staffed and equipped for the purpose of carrying out all the various measures in regard to breeding, feeding, disease control, management and marketing which were necessary for improvement of cattle. The bulls produced from these areas, which would be of known pedigree and productive, were to be distributed in a systematic manner all over the country, so that the improvement might spread in the country in an ever-widening circle. The scheme when fully established was expected eventually to produce 60,000 pedigree bulls per annum to serve the needs of the country.\textsuperscript{82} The term key-village was expressively worded as it was designed to hold the 'key' to the success of cattle improvement. The plan evolved as a result of experience gained which showed that Government cattle breeding farms alone did not lead to any appreciable improvement in cattle and that "this should be done in suitable areas in the villages under the villagers' own conditions so that the villager may be firmly convinced of the advantages of the modern scientific methods followed or recommended by Government." The emphasis was on "half the herd", i.e., the bull: whereas a cow in her lifetime cannot produce more than 6 or 7 calves the bull can produce 300 or more calves. The crux of the problem in

\textsuperscript{81} Annexure No. 3, \textit{Vide Answer to * Q. No. 1853, The Council of Gosamvardhana, Appendix IX to HOPD, First Session, 16-26 May 1952, 681-83.}

\textsuperscript{82} Annexure No. 39, \textit{Vide Answer to Q. No. 479 (a) to (c), Key Village Model Scheme, Appendix VI to HOPD, Second Session, 1952, 505.}

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India was the production of sufficiently large number of bulls of high quality.\textsuperscript{83} ‘Key Village was the corner stone of cattle development and improvement in India.’

Agricultural Implements and Tools

In India, during the period of this study, about 90\% of the agricultural production was achieved by tools and implements made by local artisans on a cottage industry basis. In order to ensure adequate supplies of iron and steel for this purpose a separate quota of iron and steel was introduced for agricultural purposes from April 1949. In addition, most of the State Governments agreed to utilise 50\% of their yearly general scrap allocation of approximate 17,000 tons for agricultural purposes.\textsuperscript{84} Moreover, over-riding priority was given in the matter of supply of iron and steel for agricultural purposes and the supplies were moved in high-grade priority.\textsuperscript{85} The number of cultivators’ ploughs in India in 1935 was 17,432,932, though no information was available to show the number of ploughs idle for lack of oxen.\textsuperscript{86} By October 1943, agricultural machinery such as tractors, scrapers, ploughs, rooters, hay balers and pressers, pasteurizers, harrows, drills, cultivators, trailers, etc., were received from USA\textsuperscript{87} and distributed to Military centres like Government dairy farms and essential users. An approximate estimate of the requirements of such implements was made and on that basis it was worked out that at least 100,000 tons of iron and steel should be made available for the purpose every year. In addition organized implements manufacturers needed another 12,000 tons each year for the manufacture of implements. The allotment for the first half of 1945 for agricultural implements, consumer goods and unlicensed sales was about 95,000 tons of iron and steel, which was distributed through Regional Deputy Iron and Steel Controllers acting in consultation with Provincial Governments. In addition iron and steel was supplied direct by the Civil

\textsuperscript{83} Enclosure No. 19, Vide Item No. 74, Key-Village for the Development of Cattle in India, Appendix I-V to the PD, Fifth Session, 1952, 329-32.

\textsuperscript{84} Annexure No. 5, Vide Answer to * Q. No. 1363 (a), Note indicating the steps taken to promote wider use of agricultural and forestry supplies and equipment, Appendix IX to PD, Fourth Session, 26 September-5 October 1951, 676-77.

\textsuperscript{85} Annexure No. 6, Vide Answer to * Q. No. 677, Appendices XV to XXI to the CAILD, Sixth Session, November-December 1949, 314-5.

\textsuperscript{86} Reply by Secretary for Education, Health and Lands Mr. J.D. Tyson to Q. No. 143 Re. Cattle, Ploughs, etc., in India by Bhai Parma Nand, LAD, 3.3.1941, 1527.

\textsuperscript{87} Reply of Supply Member Dewan Bahadur Sir A. Ramaswami Mudaliar to * Q. No. 307 Re. Import of Farm Machinery from America by Mr. T.T. Krishnamachari, LAD, 3.3.1944, 794.
Licensing Authority to organised implements manufacturers.\(^{88}\) Tractors could be used in India except in marshy or waterlogged land or for the cultivation of wetland rice. In the case of marshy or waterlogged lands tractors could be used after the lands were properly drained.\(^{89}\) The number of tractors imported or purchased by Government during the three years between 1946 and 1948 was 569. These were largely used in areas where there was no hand-labour and were doing the work which ordinary hand-labour could not do.\(^{90}\) According to the policy during the period of this study, import of tractors of less than 15 H.P. at the draw bar and those operating on petrol was completely banned, as they were not considered suitable for general agricultural work under Indian conditions.\(^{91}\) By 1954-55, there were 3013 tractors imported from UK, USA, Canada, W. Germany, Czechoslovakia, Austria, Rumania, USSR, Italy and Federation of Malaya.\(^{92}\)

A conference on Agricultural Implements and Machinery was held at New Delhi on 8-9 January 1953, which recommended steps to improve the indigenous implements in common use in the country as well as those, specific to a particular region. A survey of the indigenous implements in use was suggested to provide basic data for carrying out improvements.\(^{93}\)

A technical Co-operation Programme Agreement between the Government of India and the Government of the United States of America was entered into on January 5, 1952 for the purpose to bring about an immediate increase in food and agricultural production by making available to the farmers of India improved agricultural implement and equipment such as steel-point ploughs, spike-tooth harrows, steel cart tires, irrigation devices and steel fencing. It was estimated that the demand for iron and steel for the fabrication of simple farm implements in the villages was approximately 275,000 tons per annum. The

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\(^{88}\) Reply of the Secretary, Education, Health and Lands Mr. J.D. Tyson to * Q. No. 1357 Re. Requirements of Agricultural Implements and Fertilizers by Mr. T.S. Avinashilingam Chettiar, LAD, 26.3.1945, 2027-28.

\(^{89}\) Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 975 Re. Tractors for Agricultural Development of Coastal Areas by Shri Satis Chandra Samanta, CAILD, 29.3.1948, 2643.

\(^{90}\) Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 606 Re. Import of Tractors by Pandit Mukut Bihari Lal Bhargava, CAILD, 23.2.1949, 956-58.

\(^{91}\) Annexure No. 5, Vide Answer to * Q. No. 1363 (a). Note indicating the steps taken to promote wider use of agricultural and forestry supplies and equipment. Appendix IX to PD, Fourth Session, 26 September-5 October 1951, 676-77.

\(^{92}\) Annexure No. 59, Vide Answer to Q. No. 960, Statement showing country-wise imports of Tractors during 1954-55, Appendix IX to LSD, 16.9.55, Tenth Session, 1955, 977.

\(^{93}\) Annexure No. 16, Vide Answer to * Q. No. 511 (b) to (d), The recommendations of the conference on Agricultural Implements and Machinery held at New Delhi on the 8th and 9th January, 1953 and the action taken thereon, Appendix IV to HOPD, Third Session, 1953.
internal production of iron and steel in India was insufficient to permit an allocation of more than 120,000 tons per annum for these purposes, leaving a gap of about 155,000 tons. It was also the intent of the project to further production of improved farm machinery and implements in India. There were then a number of factories that produced the latest types of farm machinery, but only a portion of their total capacity could be utilised because of the acute shortage of iron and steel. Of the iron and steel acquired under this project 39,000 tons were to be allocated and sold to village blacksmiths and farmers for the manufacture and construction of steel point ploughs, spike tooth harrows, cart tires, irrigation devices, steel fencing and other implements urgently needed by the farmers of India, and the construction of godowns and cowsheds to store and accommodate agricultural products and animals. Since the village blacksmiths are the primary fabricators of the implements used by the farmers of India, the distribution of this iron and steel was to be integrated with the Community Development Programme to insure that the steel agreed upon to be allocated to the community projects reached the villages in such project areas. In this way it was to make the maximum impact on the agricultural production of India. The remaining 16,000 tons of steel were to be allocated and sold to farm implement factories in India for the production of improved farm machinery and implements that were to be sold to the farmers of India. It was intended thereby to stimulate and further the development of an indigenous farm implement manufacturing industry that was to make available to the farmers of India farm machinery at reasonable prices.94

Manures and Fertilizers

"In this country on account of poverty, as you know, Sir, the manure which is in the shape of cow-dung, is used as fuel."95 India's manure requirements, during the period of our study, fell short of the total quantity necessary for the area under plough. Government of India, therefore, encouraged the development and utilization of all local resources for preparing manure. The work relating to the composting of rural wastes such as cow dung,
farm wastes and litter was taken up by the Government of India in 1944 under the Grow More Food campaign. Since 1943-44, the Government of India, under a State Trading Scheme, purchased the indigenous production of Sulphate of Ammonia and pooled with the quantities of imported fertilisers and sold at pool prices fixed from time to time on 'no-loss no-profit' basis. Allocations out of the Central Pool were made to the State Governments on an annual basis according to their requirements. Separate allotments were made for commercial crops such as jute, cotton, tea, coffee and rubber, etc. For a planned distribution of phosphatic manures at reasonable rates a Central Phosphatic Pool was started in 1948. Under this pool, the entire local production of super phosphate was purchased by Government from local manufacturing concerns at prices recommended by the Tariff Board and sold to different States at a uniform price fixed on a 'no-profit no-loss' basis. The use of compost manure was an important aid in the production effort and the Government gave an important place to Compost Development in the production programme. The State Governments of Orissa, Mysore, Hyderabad and PEPSU modified their Municipal Acts to enable them to require Municipalities to convert all available refuse into compost manure and other State Governments contemplated similar legislation. By 1947, schemes were initiated for increasing the quantity of Compost prepared in villages; in certain areas by the award of prizes and subsidies. 8,000 villages operated the scheme, and their total production was about 12 lakhs tons of manure per year. Schemes were also started in some towns for converting urban refuse into manure. About 600 municipalities prepared about 500,000 tons of Compost per year. A factory producing 7,500 tons of Sulphate of Ammonia operated in Mysore; another factory producing 50,000 tons of Sulphate of Ammonia operated in Travancore State. The Government of India contemplated establishing a factory at Sindri with a capacity to manufacture 3, 50, 000 tons of Sulphate of Ammonia. The Government imported maximum possible quantities of fertilizers allotted to India by the International Emergency Food Council and available from other sources. The export of uncrushed

96 Statement I placed on the Table of the Constituent Assembly of India (Legislative) by Minister of Agriculture Shri Jairamdas Doulatram in reply to * Q. No. 1602 Re. Use of Cattle Dung as Manure by Pandit Mukut Bihari Lal Bhargava, 4,4,1949, 2073-76.
97 Annexure No. 5, Vide Answer to * Q. No. 1363 (a), Note indicating the steps taken to promote wider use of agricultural and forestry supplies and equipment, Appendix IX to PD, Fourth Session, 26 September-5October 1951, 676-77.
bones and bone meal was banned and the production and distribution of bone meal and super-phosphates in the country was encouraged. Rock-Phosphate was also imported for conversion into super-phosphate. Only a limited quantity of oil cakes, oil-seeds and crushed bones and bone-grist was exported from India.\(^9\) Bone meal was generally found to be effective in acid soils while very little response was obtained to this fertiliser in soils that were on the alkaline side. Indian experience was in agreement with this general finding. The best effect of bone meal was generally observed when it was used in conjunction with manure containing large quantities of organic matter, particularly green manures. In that case the substance produced by the decomposition of green manure assisted the solution of the phosphoric acid of the bone meal and thus made the latter much more available for the plant than would otherwise be the case. The bone meal generally gave higher yield in the second crop, as it required some time to decompose.\(^9\) The manurial value of oilcakes was generally proportionate to their Nitrogen content. For example, the Nitrogen content of non-edible oilcakes was: Castor cake (4.37%), Neem cake (5.22%), Mahua cake (2.51%), Dhupak cake (1.13%), Karanj cake (3.97%), and Undi cake (3.63%). Expellers, rotaries, and country ghanies produced the different kinds of oil cake.\(^1\)\(^0\) Government set up a special committee, the Organic Manure Committee to concentrate on the work of organic manure, and the idea was to develop units in all the provinces and try and mobilise their agricultural departments to encourage the production of farm-yard manure, green manure and compost.\(^1\)\(^1\) As a result of special investigations carried out under the auspices of ICAR at the Indian Institute of Science, Bangalore, the economic sanitary and agricultural factors were incorporated into an improved system of compost-making, which was given extensive trial at several municipal centres in the Bombay province, with very encouraging results. Several of the municipalities found the method of composting so satisfactory from the hygienic and economic aspects that

98 Reply by Minister of Agriculture Dr. Rajendra Prasad to * Q. No. 134 Re. Supply of Fertilising Material by Shri R. R. Diwakar, CAILD, 20th November 1947, 291-93.
99 Statement 1 Experiments on Bone meal placed on the Table of the Constituent Assembly of India (Legislative) by Minister of Agriculture Shri Jairamdas Doulatram in reply to * Q. No. 245 Re. Ban on Export of Bones and Use of Bone-Meal and Human Waste as Manure by Shri R. R. Diwakar, 16.8.1948, 292.
100 Reply by Minister of Agriculture Dr. Rajendra Prasad to * Q. No. 135 Re. Edible and Non-Edible Oil Cakes by Shri R. R. Diwakar, CAILD, 20th November 1947, 293.
numerous municipalities in India adopted the process on a routine basis in order to deal with the whole of the daily output of refuse. This increased the manurial resources of the country to a large extent. A special impetus was given to it as a “Grow More Food” measure in all the provinces of India and some States. The Government of India sanctioned a sum of Rs. Two and half lakhs to ICAR for the purpose of training the staff of Provincial and State Governments in the Bangalore process of compost making. Provinces were asked to submit schemes for preparation of compost from urban and village refuse. In August 1948 the Government of India took over supervision of the schemes. Under the urban and rural Compost Schemes, 566 Urban Centres and 27,950 Village Centres produced respectively 4, 86,080 tons and 12, 58,986 tons of compost from town and village refuse by 1947-48. For encouraging compost manure, seedlings of quick growing trees were distributed free of cost to help the villagers to substitute other cheap fuel for cow-dung, which was an important ingredient in the preparation of compost. For rural compost making, technical advice and prizes for the largest amount of compost prepared by individual cultivator were given. In respect of urban compost making, the Municipalities were given loans for the purchase of equipment and trucks for solving the transport problem. The village compost schemes involved the use of village waste materials such as cattle shed wastes, litter, house-sweepings, etc., and not human waste. In pursuance of the recommendations of the All-India Compost Conference and the Central Manure (Compost) Development Committee, the conversion of village night soil into manure by the adoption of Wardha system of Trench Latrines was contemplated during this period.

As regards use of chemical fertilizers during the period of our study, the available opinion of experienced Agricultural Officers was that fertilizers by themselves were useful but that they should be used judiciously by reference to the particular nature and extent of deficiencies in the soil and the type of crops intended to be grown; that the use

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102 A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op.cit.
103 Response of Shri Jairamdas Doulatram, Minister of Agriculture to Q. No. 96 Re. Manufacture of Compost and its Use in Provinces and States by Shri B. Shiva Rao, CAILD, 11.8.1948, 135-36.
104 Annexure No. 6, Vide Answer to Q. No. 677, Appendices XV to XXI to the Constituent Assembly of India (Legislative) Debates, Sixth Session, November-December 1949, 314-5.
105 Response of Shri Jairamdas Doulatram, Minister of Agriculture to Q. No. 245 Re. Ban on Export of Bones and Use of Bone-Meal and Human Waste as Manure by Shri R.R. Diwakar, CAILD, 16.8.1948, 290-91.
of fertilizers did not lead to the deterioration of soil fertility within a short period; that the
danger lay only in using fertilizers indiscriminately. The then Minister of Agriculture
Shri Jairamdas Doulatram informed the Constituent Assembly of India (Legislative) on
20.8.1948: “Several experiments have been conducted in India and elsewhere on the use
of fertilizers. The following literature gives information on the subject: (i) ‘Report on Soil
Fertility Investigations in India with special reference to Manuring’ by Dr. A.B. Stewart,
(1945), Manuring of Cotton in India, Bulletin of Indian Central Cotton Committee, (iv)
Rege, (1941), Fertilizer Experiments on Sugarcane in India, 1932-39, ICAR Misc
Bulletin No. 41, and (v) Sahasrabuddhe, (1934), Experiments in Manuring Crops in the
opinion on the use of such fertilizers was that their judicious use improved yields of
crops.106 Before the war, India used only 100,000 tons of chemical fertilizers in a year;
some 20,000 tons of Ammonium Sulphate were produced in India in addition to a small
quantity of Super phosphate, the rest being imported. In 1944 some 58,000 tons of
Ammonium Super phosphate were imported and in the first half of 1945 another 30,000
tons were expected. Comparatively small quantities of other chemical fertilizers were
also received. Indents were placed for importing 171,000 tons of Ammonium Sulphate in
1945-46 in addition to other fertilizers. The imports were distributed through Provincial
Governments.107 All fertilizers purchased by the Government after 1944 were controlled
by the Central Government and were allocated to the various Provinces and States for
distribution. The Central Government subsidized the distribution of Sulphate of
Ammonia for use on food crops mainly paddy. The subsidy varied from 50 per cent to 25
per cent of the cost of the fertilizer. This made the cultivators more fertilizer-minded. The
Department of Agriculture did not advocate the use of fertilizers in preference to organic
manures. Fertilizers were recommended for use in conjunction with whatever organic
manure was available. Since large quantities of organics were not available to give
sufficient plant food to the growing crops, application of fertilizers helped to distribute

106 Reply by Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 325 Re. Use of Chemical
Fertilisers by Mr. R.K. Siddha, CAILD, 20.8.1948, 408.
107 Mr. J.D. Tyson, Member for Education, Health and Lands in response to * Question No. 1357 Re.
Requirements of Agricultural Implements and Fertilizers by Mr. T.S. Avinashilingam Chettiar, LAD,
the organics over a wider area and at the same time provided the necessary plant food in a more readily assimilable form. Fertilizers were not applied to increase the fertility of the soil but to produce bigger yields of crops. The plant food in the fertilizer was readily available to the crop. "Judicious use of fertilizers increases the yield of crops by 20 per cent. to 40 per cent."¹⁰⁸ But chemical fertilizers were hardly within the reach of the cultivator. And on account of his poverty, the manure which came in the shape of cow-dung, he used as fuel; while the use of oil cakes as manure competed with its use as food for livestock. By 1949, there were 12 factories in India for the manufacture of manures and chemical fertilisers on modern lines, none of which was State-owned. Their total annual output in 1948 was 56,300 tons; 35,000 tons of Ammonium Sulphate and 21,300 tons of Super phosphate. One State-owned factory for the manufacture of Ammonium Sulphate with an estimated capacity of 3, 50,000 tons per annum was still under erection at Sindri. Additional capacity for the production of super phosphate was also encouraged to be set up by private enterprise. Similar plans were also under preparation by private enterprise for the installation of additional capacity for the manufacture of ammonium sulphate. Experimental results of research of immediate practical value obtained at the Central Rice Research Institute, Cuttack, in 1950 indicated that the application of ammonium sulphate in dry condition of soil, two to three weeks before transplanting, gave an increased yield of about 100 lbs. per acre over the yield by the customary method of applying the fertiliser in puddle condition either at transplanting or soon after; that the base dose of organic manure e.g., compost and top dressing of the inorganic fertiliser gave the maximum yield response. The application of 4 tons of compost per acre, supplemented by 100 lbs. of ammonium sulphate gave an increase of about 626 lbs. of paddy per acre over the basic yield of 2,152 lbs. per acre.¹⁰⁹

A large number of experiments were carried out in different provinces, on manurial, varietal and agronomic aspects of different crops and sufficient information was gathered. But despite this accumulation of knowledge, few recommendations of the Provincial Departments of Agriculture were adopted in general practice by the general body of

¹⁰⁸ Sir Pheroze Kharegat, Agriculture Secretary in response to * Q. No. 758 Re. Import of Artificial Manure by Mr. B.P. Jhunjhunwala, LAD, 6.3.1946, Vol. III, 28 February -14 March, 1946, 1965.
¹⁰⁹ Annexure No. 29, Vide Answer to * Q. No. 2021 (a), PD, Appendices X-XXXIII, Third Session, 2nd Part, 1950-51, 1070.
cultivators. Generally, the crops grew well on Government farms wherever situated. But little improvement was visible even in the fields of cultivators adjoining those farms. One aspect that needed urgent attention in this connection was that the results of experiments conducted at Government farms needed confirmation on cultivators' fields. The question of translating the results of research into cultivators' practice had engaged the attention of the ICAR since long and they invited experts periodically to review the work of the Council with a view to make suggestions for effecting improvements particularly in this direction. For example, Sir John Russell, who reviewed the work of the ICAR in 1937 emphasised the need of carrying out simple experiments on cultivators' holdings to bridge the gap between the experimental station proper and the cultivators' fields. He pointed out that the results obtained on well-known farms needed confirmation under village conditions and that such experiments formed the first step in demonstration. The Joint Committee of the Governing Body and the Advisory Board specially constituted to explore the means of bridging the gap between the experimental station and the cultivators' fields recommended in July 1938 that the Council's expert Advisers and Statistical Adviser should assist in the planning of Simplified experiments on cultivators' holdings. The actual carrying out of these experiments was to be left to Provincial Governments. The report of the Joint Committee was adopted both by the Governing Body and the Advisory Board in their meetings in 1938. The Statistician of the Council helped the Provincial Governments in the planning of such experiments whenever the request for such help came. But unfortunately there was little improvement in introducing improved practices in the cultivators' fields. The Council invited Dr. A.B. Stewart, in 1946, to review this aspect particularly and make definite recommendations. His published report was circulated to the Directors of Agriculture of the various Provinces and States and members of the Regionalisation Committee. Dr. Stewart made detailed recommendations and laid down lines on which the work was to be carried out for achieving effective results. According to him, failure to achieve, under ordinary agricultural practice, large-scale production of the high yields of many Government farms was due to two main causes viz.

"(1) the soils of India have been undergoing progressive impoverishment over a long period and because of his own poverty, the cultivator cannot afford the cash outlays
which are involved even in relatively small-scale improvement measures,
(2) there is a lack of sound information on what exactly is needed to overcome the poverty of the soils under the widely differing conditions obtaining throughout India.”

The first of these had widespread social and administrative implications and needed the attention of various departments. The second required more careful and detailed work to elucidate the effects of various factors that made individual, aggregate and cumulative contribution to the high productivity of Government farms. The then knowledge of the effects of individual nutrient supplements under different soil and climatic conditions was inadequate. To investigate that fully, he suggested that in planning and conduct of future work, consideration was to be given to two main types of experimentation.

(a) Simple experiments in fields of cultivators to test the most promising results of past work.
(b) Research and detailed experimental work at carefully selected centres supplementary to existing Government farms.

A scheme was formulated in accordance with these recommendations of Dr. Stewart.110

Importance of fertilisers in food production was traditional knowledge. On the desirability of using tractors and chemical fertilizers, Shri Biswanath Das wished to know in the Constituent Assembly (Legislative) on 11.8.1948 whether Government had read and examined the views of Prof. Albert Einstein, and considered the views expressed by Mahatma Gandhi and Kumarappa of the All-India Village Industries Association on the question of the use of tractors and Chemical manures as fertilizers. The Minister of Agriculture Shri Jairamdas Doulatram said: “Government are aware of the view held by some that chemical fertilizers are harmful to the soil. Government want to place full emphasis on the use of organic manure. But they do not yet wish to reject the experience of other countries that have benefited by the judicious use of chemical fertilizers. In India, Government have favoured the use of organic manure mixed with chemical fertilizers as has been recommended on the strength of numerous experiments in various

110 Annexure No. 59, Vide Answer to * Q. No. 1004 (c), Re. A scheme for accelerating the tempo of work on manural, varietal and agronomic trials in order to determine optimum yield. Appendix VI to HOPD, Third Session, 1953, 525-27.
countries and India itself."

**Animal Nutrition: Fodder crops and grasses**

By 1931, the Imperial Council of Agricultural Research started to finance this subject, first at Dacca and then in Madras, Bihar, U.P., Punjab, Assam and Bombay. At Dacca, the main work was directed towards the peculiarities of the nutritive value of the rice straw; the adverse effect upon calcium stilisation and thus upon growth of the animal body was discovered; the modification in feeding practice necessary to counteract it were indicated after work at the Indian Veterinary Research Institute explained how the calcium was leached. At Coimbatore, among other things, the general nutrition of milch cattle was studied with special reference to their mineral requirements; a survey of the pastures of Madras with regard to their mineral content was also undertaken and the effect of soil treatment on crop composition was examined; some fundamental research was also attempted. Requirements of calcium and phosphorous for Madras milk cattle were discovered and the relation of deficiencies of these minerals in pasture with under development of cattle was demonstrated. In Bihar, a study of the chemical composition of common fodder and grasses was carried out. In the United Provinces, the nutritive value of these substances was the subject of study and the relative value of common grasses, fodders and concentrates were determined so that the cattle owner could be reliably advised on what substitutes could be used when the usual cattle food was not available. In the Punjab, and at the Indian Veterinary Research Institute, the actual nutritional requirements of various classes of animals and for various forms of production were determined, as well as the nutritive value of most of the common fodders and some special concentrates. In Assam, a study was made of the value of various grasses and work was directed to the discovery of the best means of fodder conservation. Experiments in grass drying by artificial means were tried in Bombay, but discontinued when it was discovered that process was probably impracticable in Indian conditions. At the Indian Veterinary Research Institute Nutrition Section the feeding value of possible famine foods was determined, and the method by which unused material could be made fit for use was demonstrated, such for instance as the preparation of thorny fodders, munj and kans grass, the kernels of the mango-seeds and of waste of offal from the slaughter

houses. Modifications of the Lehmann process of straw digestion was tried on a field scale but it was considered that although the value of rice straw was improved 60 per cent., the method was probably impracticable under conditions then. On the other hand, it was shown that rice straw was greatly improved when washed simply with water. The nutritive value of leaf fodder also formed the subject of special research as well as that of United Provinces grasses in all stages of growth and environment. A study of the nutritive value of vanaspati and ghee suggested that if the former was consumed in a diet on the borderline of vitamin and calcium requirements, the effect might be decidedly adverse, though that remained to be confirmed then. An experiment completed in Malabar showed decisively that climate by itself played a comparatively minor part in the defective growth and development of animals when compared to an unbalanced or insufficient diet and to the effects of parasitism. Two experiments were carried out to see if there was any foundation for the objection of farmers to feed fuzzy cotton in the Punjab and groundnut cake in Baroda. It was shown that both could be fed with impunity and profit. In Madras, a laboratory in the Medical College was financed to confirm or refute the commonly held opinion concerning the danger of poisoning by certain common plants and to discover the value of indigenous medicinal plants and drugs. It was considered that if some method acceptable to the farmer of conserving surplus grass grown during the rains could be evolved, the biggest problem of animal feeding would be solved. Grassland research was considered to be taken up, as was elsewhere, as a specialised line of work.\(^{112}\)

Since pasture is and possibly will always be the main food of livestock, the development of pasture grasses and legumes was a matter of paramount importance not only from the point of view of pasture improvement but also from that of preventing soil erosion and increasing soil fertility. During the period of this study, India was deficient as regards the fodder requirements of her livestock population. It was estimated that using all the available cattle feeds in the country there was a gap of 61 per cent in the concentrates and 43 per cent in the roughage between what should be fed and the available supply. The consequent undernutrition was to a large extent responsible for the deficit in milk

\(^{112}\) A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op. cit.
production so essential for the health of the people and the dearth of draught power so vitally needed for efficient farming. The Central Fodder and Grazing Committee, a sub-committee of the ICAR, at its meeting in Simla in June 1940 while examining fodder and grasses schemes for the various provinces pointed out the need for organising future work in a standard pattern of experiments including breeding of grasses, feeding value, disease producing organisms and parasites that may be carried by the grass, control of grazing area, utilisation of grasses as hay, silage, etc. The Madras meeting of the Crops and Soils Wing of the Board of Agriculture held in April 1948 recommended that fodder production should be given high priority and all avenues to increase fodder supply should be explored; that each province and state should establish agrostological section to study the problem in all its aspects viz. collection of indigenous and exotic grasses, trial under local conditions with regard to their cultural, manurial and hygienic requirements; that experiments should be undertaken to work out on comparative data regarding economic and nutritive returns from the known perennial grasses and alternative cultivated fodder; that the possibility of utilising waste-lands in the village, field and tank bunds for growing suitable forage plants should be explored; that the system of rotational grazing should be extended to suitable forest and waste-lands all over the country; that, for this purpose, removal of scrub jungle, conservation of moisture on sloping land and provision of water facilities to improve estaurial grazing be made; that, though improvement of existing fodder crops was in progress in different provinces and States, there was much scope for more intensive and co-ordinated work; that the exploration of new grasses including perennial legumes, exotic and indigenous, assessing their suitability, nutritive value, toxicity if any to animals, were some examples. The Committee also suggested the compilation of an illustrated Handbook of Indian Fodder and Forage Plants by the Council. There was thus an urgent and vital need for developing pasturelands in India with suitable grasses and legumes either separately or in mixtures, which would furnish large quantities of palatable and nutritious fodder for livestock under varying conditions of rainfall and at the same time enrich the soil. There were various programmes of research and development for fodder crops and grasses. The first step was to make a survey and collection of pasture grasses and legumes from as wide range of places all over the world, as the wealth of plant material was the key to ultimate success in the
development of suitable plants for pastureland. A scheme financed by the Council for 5 years from April 1946 was operated in the Botany Division of the Indian Agricultural Research Institute for the introduction of new economic plants, including Fodder and Forage Grasses. A list of these was published in the October 1949 issue of ‘Indian Farming’. It was decided that survey and collection of pasture grasses and legumes from inside and outside India was to be done by ICAR. Collaboration of the Forest Departments of the regions were sought in the following items of work: determination of the optimum intensity of grazing on different types of pasture, forests as well as open; study of leafy fodders; and, comparison of grass cutting with rotational grazing and intensive grazing. The items of work consisted of the following three categories: survey and collection of indigenous and exotic pasture grasses and legumes from a wide range of places; breeding high yielding, palatable and nutritive ecotypes of grasses and legumes for the different climatic and edaphic regions. The criteria in breeding was a desirable vegetative characters including high yield of good forage, wide adaptability, good seeding habit, low water requirement, resistance to disease, drought and frost, ability to produce Sod, and good response to fertilisers; and, agronomic investigations including the determination of the best mixtures of legumes and grasses, cultural irrigational and manurial requirements of the various forage plants and their growth singly or in rotation with other crops studied. Grasses were obtained from U.S.A., Australia, and South Africa for trial and acclimatisation. The I.C.A.R. sanctioned combined agricultural and animal husbandry research schemes (Mixed Farming Schemes) in U.P., Central Provinces, N.W.F.P. and Sind as well as “Project” schemes in Bombay, U.P., C.P. and Travancore for all round agricultural and animal husbandry improvement in villages. In addition to these, a pastureland scheme was in progress in Baroda and two others were sanctioned for the Punjab and Bengal. The results of these schemes were expected to indicate the lines on which development of farming in villages should proceed. Experience and tradition had probably taught the farmer more about feeding his animals under the conditions in which he found himself than scientists had yet then learnt. Nevertheless they offered him to certain practical results of their work, e.g., the

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113 Annexure No. 2, Vide Answer to * Q. No. 4044, Scheme for the improvement of Pasture Grasses and Legumes in India, Appendix XXV to PD, Third Session, 2nd Part, 1950-51, 1756-59.
enhancement of the feeding value of rice straw by washing; the use of Munj and Kans
glass by ensilage; the use of fish meal, bone meal and other animal products as a valuable
addition to the supply of protein and concentrates; the advantages of rotational and
controlled grazing, etc.¹¹⁴ Provincial and State Governments took various steps to increase
the production of fodder so far as possible. Sewage water was also utilised for the
purpose. For instance, by 1948 in Madras trial of different kinds of grasses, growing of
fodder trees on Government waste lands, and rotational grazing in Panchayats and
reserved forests was undertaken for increasing fodder supply; sewage fodder farms were
already functioning in Madras, Mathurai and Ootacamund where alone underground
sewage system existed. In U.P. improved varieties of grasses and vines were grown on
mechanised farms; many grasses imported from Australia were tried; import of many
British and African grasses was contemplated; and nutritive value of fodder grasses and
other cultivated fodder was published. Some work on fodder cultivation on sewage
manure was done at the Agricultural Institute, Allahabad, though sewage was chiefly
used for vegetable farming in the province. In Jaipur, hand chaff cutters were introduced
to avoid waste of fodder, Government distributed fodder seeds, and private farmers who
grew vegetables from sewage manure were directed to grow fodder for increasing fodder
supply. In Jodhpur, formation of fodder reserves in villages on experimental basis,
experimental cultivation of fodder grasses on dry farming, reclamation of unproductive
areas infested with shrubs, encouraging co-operative farming on improved method and
cutting, and Fodder Co-operative Societies for collection, purchase and sale was
undertaken for this purpose. Also, the Sewage Farm, Jodhpur was set up in early forties
with an area of 103 acres, though the available sewage manure was enough for 15 acres
only on which Lucerne, Rhodes and Napier grasses were grown for augmenting fodder
supply.¹¹⁵ The composition and feeding values of a large number of fodder grasses and
concentrates of various regions were studied at the Animal Nutrition Division of IVRI,
Izatnagar and results were published in Miscellaneous Bulletin No. 25 of ICAR along
with the instructions for utilising these grasses for the computation of rations.

¹¹⁴ A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture
side, op. cit.
¹¹⁵ Statement placed on the Table of the Constituent Assembly of India (Legislative) by Minister of
Agriculture Shri Jairamdas Doulatram in reply to * Q. No. 953 Re. Steps to increase Production of Fodder
by Shri Moturi Satyanarayana, 8.3.1949, 1336-40.
Considerable work was completed on the palatability and chemical composition of tree leaves as affected by maturity, soil and climatic conditions. Most of the tree leaves were characterised by their richness in protein and calcium. The nutritive values of a large number of tree leaves in different seasons were also examined. Some of the leaves had good feed values and often could be relied upon to provide substantial nourishment to the animals, especially during the periods when better types of roughage were not available. The Soil Conservation Society of India in view of the importance of grasses in soil conservation and for cattle feed requirements recommended the intensification of research on grasses specially the drought resisting ones and to multiply the seeds of promising types for distribution, and organisation of demonstration pilot projects for controlled grazing in village grasslands in collaboration with the farmers through their village Panchayats.

Irrigation

Irrigation is the artificial application or process of supplying water to crops in countries where the rainfall is insufficient or comes in the wrong season. Artificial supply of water played an important role in agriculture all through history. In most areas, therefore, the state of agriculture depended vitally upon the security and flexibility provided by irrigation facilities - a point long recognized in India. It is a truism, therefore, that the availability of water determines, more than any other input, the nature of agricultural production; that water is the most important compound for all living beings; that if water is not made available to plants, animals and human beings, they all will die; that water is needed for their life processes; and that land, soil and water are the basic resources needed for agriculture. India is both fortunate and unfortunate in having a rainy season, which provides a kharif crop of a type which is easy to cultivate but which takes a lot out of the soil for little return. Apart from this, there are dry season crops which depend largely upon irrigation and which are most important. In view of the ‘Grow More Food’ campaign during the period of our study, steps were taken to survey sub-soil water for

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116 Annexure No. I, Vide Answer to * Q. No. 1682 (b), Statement showing the result of the study of fodder grasses and fodder trees of various regions, Appendix X to LSD, 24.4.56, Twelfth Session, 1956, 953.
117 Annexure No. 55, Vide Answer to * Q. No. 1862, Statement re. recommendations of the Soil Conservation Society of India, Appendix XI to LSD, 6.9.56, Thirteenth Session, 1956, 1197-98.
irrigation. For this purpose a Central Sub-soil Water Section was set up under the Irrigation Adviser in 1944 to advise the Provinces as regards suitable tracts for tube well irrigation, to carry out trial borings and to collect and co-ordinate data regarding sub-soil water supplies. The Irrigation Adviser went to the United States of America to secure the necessary machinery. A training class in the use of these boring rigs was organised at Dhanbad. Since the possibilities of getting adequate supplies of sub-soil water for irrigation purposes in the alluvial tracts particularly in the Indo-Gangetic plains were known, these were developed according to the availability of machinery. In the non-alluvial tracts of India, sub-soil supplies of irrigation water were surveyed.119 Possibilities for extension of irrigation facilities lay in the direction of extension of surface storage by means of tanks and reservoirs, flood irrigation, field embankments and river pumping schemes. For example, there was an increase of 4.6 lakhs of acres in the irrigated area in the Central Provinces and Berar between 1938-39 and 1946-47. One project in Balaghat for irrigating 5,000 acres was sanctioned for which the Government of India gave a subsidy of 5.5 lakhs.120 Major schemes -both productive and protective- for flood control, irrigation and electricity like the Damodar Valley Scheme in Bengal and Bihar; Mahanadi Valley Scheme in Orissa; Kosi Dam Project in Bihar and Nepal; Narbada, Tapti and Sabarmati projects in Bombay, Central Provinces, Baroda and Central India and Kathiawar States; Indravati and Sabri Schemes in Bastar State; Brahmaputra, Barak and Someshwari rivers valley development schemes in Assam; Sone Valley scheme in Bihar, United Provinces and Rewa State; Bhakra Dam Scheme in East Punjab; Rihand Dam and Nayar Dam Schemes, and Ramganga Dam Project in the United Provinces; Mor Project in West Bengal; Tungabhadra and Rampadsagar projects in Madras; Lakshmanteertha Project, Harangi Project and Barapole Schemes in Coorg; Dochi Dam Scheme in Patiala; and Chambal Scheme of Kotak, Indore and Merwar States were contemplated, and surveys and investigations done during this period. All these schemes and projects were expected to give protection from famine in addition to being useful to the ‘Grow More Food’ campaign. As the then Minister of Works, Mines and Power Shri N.V. Gadgil said: “I should like to state that just like a popular song the river valley projects have caught

119 Reply of Sir Pheroze Kharegat, Agriculture Secretary to Q. No. 1011 Re. Survey of Sub-Soil Water for Irrigation by Dr. Sir Zia Uddin Ahmad, LAD, 15.3.1946, 2461.
120 Ibid.
the imagination of the people but there are other limiting factors which have got to be taken into consideration, such as adequacy of technical man-power and finances.”

Since irrigation and water supply are important aspects in developing agriculture, irrigation on large scale was one of the many benefits contemplated to be derived from the various multi-purpose projects like Hirakud (11,00,000 acres), Kakrapara (6,00,000 acres), Damodar Valley Project - Tilaiya Dam (40,000 acres), Konar Dam (50,000 acres), and other projects under investigation like Kosi (34,50,000 acres in Bihar and 6,50,000 acres in Nepal), etc. “The Bhakra Dam scheme is in a position to solve the long staple cotton problem of India and with the large area to be irrigated and the potentiality for the production of the food grains, it could substantially improve the food position of India.”

Post-Independence planning resulted in the State taking up a number of large-scale public works like road-building, dam raising and the construction of mammoth flood-control measures, such as the Kosi and Gandak embankment systems. About the river valley projects and schemes Jawaharlal Nehru said: “Here is something new that you are building out of nothing; new land brought into cultivation, many new things which you are creating out of the enormous power of the river valley projects.”

Agriculture, in harnessing nature, reconstructs the environment.

In order to overcome the delays in boring tube-wells arising out of the controls and regulations, it was proposed, in 1950, that private individuals and cooperative societies who wished to construct such tube-wells were to be given a consolidated permit for the immediate supply of all the essential materials required. The Government of India recommended to the States the need for inviting experienced firms to take up the work in order to produce prompt results. The contract for constructing 1,000 tube-wells in Punjab, UP and Bihar was finalised. For a State like Bombay, it was thought not difficult to

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122 Statement III, Benefits to be derived from the multi-purpose projects under construction or under investigation, Annexure No. 33, Vide Answer to * Q. No. 2574, PD, Appendices X to XXXIII, Third Session, 2nd Part, 1950-51, 1332-37.
123 Annexure No. 7, Statement II, Progress made on the Bhakra Dam Project, Appendices X to XIV to CAILD, Sixth Session, November-December 1949, 243.
124 Jawaharlal Nehru’s Speeches, Volume One, September 1946 - May 1949, Publications Division, Ministry of Information and Broadcasting, Government of India, 1949, 127. Speech in the Constituent Assembly of India (Legislative) during the debate on the Industrial Policy Resolution moved by the Minister for Industry and Supply Dr. Syama Prasad Mookerjee, April 7, 1948.
construct 600 tube-wells within two years; prospecting for wells in Bombay and Saurashtra was undertaken; Madras also had a scheme for tube-wells. It was expected to construct a maximum of 3000 tube-wells by 1952.125 A Technical Cooperation Programme Agreement between the Government of India and the Government of the United States of America was entered into on January 5, 1952 and supplemented on November 3 the same year to undertake a nation wide survey of the economic supplies of ground water in India for purposes of irrigation and related uses. Lack of adequate rainfall in most areas of India made it important that every available water resource was developed for irrigation purposes. India was developing its river water resources to the utmost but the maximum development of such resources could only irrigate about forty percent of the land. It was important, therefore, that every effort was made to develop the ground water resources of India to increase agricultural production. At that time the Government of India and the States of PEPSU, Punjab, Uttar Pradesh and Bihar conducted extensive programmes of ground water irrigation in areas where ground water resources proved adequate for such purposes. It was believed that other parts of India might prove equally productive for ground water irrigation but before any large-scale development programme was undertaken in such areas it was necessary to conduct exploratory studies and surveys of their ground water potential. This project proposed to drill approximately 350 exploratory wells in suitable areas throughout India for the exploration of the ground water potentialities. Principally those areas considered geologically favourable for the occurrence of productive water-bearing formations were to be explored with the view to obtain geological and hydrological data required for sound and economical development of ground water resources for irrigation and related uses. These included the Purna Basin and Narbada Valley (Central Provinces), Tapti Valley (Bombay), Kutch, Travancore- Cochin, Madras (South Central Belt), Coastal Areas of Orissa, Bengal, Bihar, Assam, Bikaner in Rajasthan, Punjab, etc. It was estimated that the majority of the test borings would be approximately 500 feet in depth but in some cases it might be necessary to drill to depths up to 1500 feet in order to

125 Annexure No. 8, Vide Answer to Q. No. 90 (a), Re. Integrated Production Programme, Appendix IV to PD, Second Session, July-August 1950, 162-64.
obtain the requisite data.\textsuperscript{126} The number of tube wells drilled up to 31.3.56 i.e. during the first Five Year Plan under large Scale tube-well programmes sponsored by the Government of India in Uttar Pradesh, Bihar, Punjab, PEPSU and Bombay were 4,315.\textsuperscript{127}

**Agricultural Meteorology**

The Central Agricultural Meteorological Observatory, Poona engaged in the analytical study of crop and weather data, investigation on rainfall variability and intensity of cold wave, progress of monsoon day-by-day, surface temperature and so forth. During 1945-46, some of the schemes initiated were crop weather co-ordination, Agricultural Meteorological Section, Poona, and water-saving experiments, Sind.\textsuperscript{128} Scientific Studies related to agricultural meteorology undertaken by the India Meteorological Department during 1956, for example, included studies on radiation, evaporation, microclimates, soil moisture, soil temperature, etc., and experiments with dew gauges for the measurement of dew. Also analysis of rainfall associated with the burst of the monsoon over different parts of the country; relationship between pressure and temperature tendencies in the upper atmosphere over India; analysis of the rainfall amounts in various 5-days periods of a year during the years 1901 - 1950 at 12 selected stations in India, etc.\textsuperscript{129}

**Preventing Floods: Harnessing Nature's Fury**

Floods are recurring things in India. Therefore, besides the protective and preventive major irrigation schemes and projects already mentioned, the Government of India drew up detailed schemes on afforestation to prevent soil erosion and floods in the country during the period of the study. These included afforestation of denuded hills outside Reserve Forest in Andhra Pradesh; of arid and blank areas in Bombay; of eroded and gullied lands in Damodar Valley; of eroded and gullied lands in Chhotanagpur plateau region outside the Damodar Valley; afforestation of eroded and gullied lands in Chhotanagpur plateau region outside the Damodar Valley; anti erosion and afforestation

\textsuperscript{126} Annexure No. 57, Vide Answer to Q. No. 1462 (b), Technical Cooperation Programme between the Government of India and Government of the United States of America, Operational Agreement No. 12, Project for Ground Water Exploration, Appendix IX to HOPD, Third Session, 1953, 767-70.

\textsuperscript{127} Annexure No. 7, Vide Answer to Q. No. 1371, Statement showing the number of tube-wells constructed during First Five Year Plan and the expenditure incurred for construction of these tube-wells during that period, Appendix X to LSD, 24.4.56, Twelfth Session, 1956, 963.

\textsuperscript{128} A brief summary of the work done by the Indian Council of Agricultural Research on the agriculture side, op.cit.

\textsuperscript{129} Annexure No. 18, Vide Answer to Q. No. 128(a), List of Scientific Studies undertaken by the India Meteorological Department during 1956, Appendix II to LSD, 21.7.56, Thirteenth Session, 1956, 160-1.
work in dry eroded lands in Hyderabad; afforestation of Catchment areas in Madhya Pradesh; of Hills behind Chandigarh, of Birs Kalsia State and afforestation and regeneration of Reserve Forests in Karnal, Hissar, etc. in Punjab; of Bhakra Dam Catchment area and of Assri and Giri rivers in PEPSU; afforestation of Dry Fuel and of Low hill areas of Madras; and afforestation of highly eroded area in upper Damodar Valley and of UP-Rajasthan border. However, in fact, the proliferations of public works proved disastrous for an unsuspecting village, for instance, like Changel in Bihar in the late 1950s and 1960s. As dams and embankments were built at great speed and road networks started criss-crossing the North Bihar countryside, the natural flow of water was severely impeded. Post-monsoon water logging became the rule in Changel, in any case located in a geological trough, suffered immensely as paddy cultivation became almost impossible. Every year the field would be ploughed and made ready in May and June, the seedlings grown and transplanted when the rains came, and then would come the devastating floods. Earlier, too, the area used to get flooded but as the water cleared after a few days, leaving behind rich deposit silt, the floods had proved beneficial. But now the water tended to stay, resulting in the rotting of the newly planted seedlings. And when the water evaporated or was eventually drained away, people further in the north and west, even more affected by water logging because their villages were nearer large public works obstructing the water-flow, would cut the embankments and roads and the second set of seedlings, which had been planted in Changel at great cost and at considerable rise in indebtedness, would be flooded again.

Impact of Researches on Indian Agriculture
In 1936 and 1937, Sir John Russell, Director, Rothamsted Experimental Station of England, after an extended tour of agricultural stations and villages reported that, “in general, the men who actually till the soil are scarcely touched by the national programme of agricultural education”. Nevertheless, a reading of the debates on researches in agriculture in India’s central legislature suggests that all out agricultural

130 Annexure No. 45, Vide Answer to * Q. No. 2468 (b) and (c), Statement showing the detailed schemes and estimates on afforestation to prevent soil erosion and floods and the estimated cost of each Scheme State-wise, LSD, 23.5.56, Appendix XIV, Twelfth Session, 1956, 1458.
research undertaken in India during the period of our study compared well with the latest developments in the world. The Royal Commission on Indian Agriculture had recommended that

the Government of India should undertake to promote, guide and co-ordinate agricultural research throughout India, and link it with agricultural research in other parts of the British Empire and in foreign countries. The Commission carefully examined the steps taken to assist agriculture by the Central Governments in the United States of America, in Canada and in Australia, where the constitution may be said to present certain analogies to India. They appear to have been most impressed by the Central organisation in Australia established for this purpose by the Commonwealth Government and have taken that organisation as the model for their proposal for India.\[133\]

That science would solve India's agricultural problems remained a cornerstone of development ideology in India after 1947.\[134\] Since all through the period of the study agriculture is a transferred provincial subject, initiative in the matter lay with Local Governments. Therefore, so far as the facilities to the farmers and the cowherds for education in rearing cattle, and taking precautionary measures against disease, the matter primarily concerned the Provincial and State Governments. The Central Government assisted these Governments by sponsoring research, giving technical advice and coordinating the work of these Governments. For example, as shown above, the Indian Veterinary Research Institute at Izatnagar and Mukteswar engaged in research in the control and prevention of disease, animal genetics, animal nutrition and allied matters; the Indian Dairy Research Institute at Bangalore researched in matters connected with dairy development and dairy education; Cattle Breeding Research Station at Jabalpur evolved a general utility type of cattle of more than average and milking capacity; and the All-India Cattle Show Committee organized an All-India Cattle and Poultry Show every year for giving impetus and encouragement to the cattle breeders.\[135\] In view of the food shortage in the country and the need for scientific planning of agricultural production, the Government of India considered it necessary to improve the method of collection of

\[133\] Mr. G. S. Bajpai's Note on the Establishment of a Central Organisation to Promote and Co-ordinate Agricultural Research, 21.6.1928, Agri/March 1929/1-3/A, pp. 20-28, National Archives, India.

\[134\] David Ludden, ed, Agricultural Production and Indian History, OUP, 1994, 10.

\[135\] Reply by Minister of Agriculture Shri Jairamdas Doulatram to Q. No. 950 Re. Education to Farmers in Rearing Cattle by Shri Moturi Satyanarayana, CAILD, 8.3.1949, 1333-34.
agricultural statistics.\textsuperscript{136} Traditionally, the village \textit{patwari} in a majority of the provinces and States supplied the data regarding crop acreages, after a field-to-field harvest inspection. In the permanently settled provinces like Bihar and Orissa, the village chowkidar traditionally supplied the data, but during the period of our study special amins were appointed to report agricultural statistics by a complete field-to-field enumeration. Government felt that judged by modern standard there was considerable room for improvement in the system of securing statistical information in regard to production of food and ensuring greater accuracy in estimates and actual yield of food grain crops in the country as a whole. The random sampling method was also in use in several provinces. Government intended to have the whole question of the system of securing accurate statistics of food production examined in consultation with Provinces and States.\textsuperscript{137}

Because agriculture usually depends on a few specialised plant species, the farmer diverts the atmospheric nitrogen to the plants of his choice by, first, removing ‘unwanted weeds’ from the neighbourhood of the favourites. In practice nitrogen (N) is the element most likely to limit plant growth. It is essential to plants, yet not readily available to them in soil. Air contains 78 percent nitrogen. Nitrogen surrounds wild plants and crops; tons of it float in the air directly over fields and forests. But plants cannot assimilate atmospheric nitrogen directly. They rely on the beneficent transformation of molecular nitrogen into forms that they can absorb and process. That job falls to microorganisms that transform molecular nitrogen in the atmosphere into ammonia and nitrate for which wild plants compete. Farmers work to divert available nitrogen toward crops that they grow for human purposes.\textsuperscript{138}

An interesting example of this may be cited from India’s Parliamentary Debates of August 2, 1950. The Minister of Food and Agriculture Shri K.M. Munshi declared an all-out war on agrimony — a genus of yellow-flowered plants, with toothed leaves, burr-like fruits and bitter taste, in no uncertain terms: “agrimony grows wild all over India but is most prolific in the North and Central India, the seed has

\textsuperscript{136} Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 981 Re. Collection of Statistics on Agricultural Produce in Provinces by Shri Lakshminarayan Sahu, CAILD, 29.3.1948, 2645.

\textsuperscript{137} Reply of Minister of Agriculture Shri Jairamdas Doulatram to * Q. No. 335 Re. Food and Crop Statistics by Shri R.R. Diwakar, CAILD, 20.8.1948, 416.

no marketable value. The State Governments have been asked to undertake legislation making it compulsory for every cultivator to remove this weed from his field, either by hand or by ploughing it up; to undertake propaganda to explain to the cultivators the harmful effects of the weed and the method of its removal. Effective eradication of this weed can only be done with the full co-operation of the cultivator. 139 Perhaps, 'the true destiny of man is to subdue the earth, and to dress and to keep it', 140 for man more than any other living organism alters the landscape, fells trees, erodes soils, dams streams, kills off unwelcome plants and predatory animals, installing favoured species in their stead. 141 Agriculture in its many forms represents the quintessence of the interaction between human beings and nature. In short, the farmers’ metier has everything to do with flows of energy through ecosystems, fluxes of hydrology, and the invisible transference of nitrogen from air to soil and back again. Farmers’ manipulation of these nutrient flows is one of the most important research stories of the past 10,000 years. 142 The farmer is the master of nitrogen management. Also, since hope sustains the farmer, he is the most dedicated researcher. Probably therefore, the tradition of education and research in agriculture in India, as elsewhere also, is as old as agriculture only because of the human need for engrossing interest in weather and water and crops and cattle, fertilizer and fodder, and the dread of famine or flood or pestilence; in short, only because of the human determination to overcome the uncertainties of weather conditions. It was understood that there were a variety of crop pests all over the world, and not only in India, as there are a variety of diseases in respect of human beings. And just as human beings die, these pests also destroy crops all over the world. This was a common malady to crops all over the world. Undoubtedly, chance natural and human designs played important roles in making, literally, ground-breaking experiments in agriculture to improve the quantity and quality of 'these nutrient flows' because, in all this long history, some of the greatest developments in agriculture were brought about by empirical

140 Otis T. Mason, the origins of invention, a study of industry among primitive peoples, (1895), The M.I.T. Press, 1966, 411.
142 Geoff Cunfer, op.cit.
Therefore, in effect, *agriculture itself is a continuous research requiring engrossing patient observation* in the 'laboratory' of the natural environment. The laboratory conditions, as ever, influencing the experiment, the latter, in turn, as ever, influencing the former.

The Government of India and the Indian Council of Agricultural Research tried to make known to the Provincial Governments and the public results of researches undertaken in their institutes or the commodity committees through periodical conferences and by means of various journals and popular publications. ICAR published two monthly journals, namely, *Indian Farming* (English) and *Kheti* (Hindi), and themselves financed a number of schemes to try out results of important researches in the fields. Improved varieties of seeds for instance were generally used for wheat, rice, sugarcane, etc. all over the country, a testimony to their efforts at publicity. They undertook schemes to develop villages in all aspects of agriculture and animal husbandry. The Ministry of Agriculture undertook on an integrated basis schemes for improvement of agriculture in all its aspects. Publicity to the research findings were also given through programmes on radio in consultation with the Provincial governments, and through documentary films. A Conference on Agricultural Information was called at Lucknow from 17th to 19th November 1952 by ICAR with the following main objectives: the setting up a net work of agricultural information machinery throughout the country for ensuring flow of scientific information from agricultural institutes, research and experimental stations to the primary producer and to ascertain his felt needs and problems for solution; enlisting the cooperation of research institutions, Government Departments, non-officials, farmers and commercial firms interested in agriculture for disseminating agricultural information; and, determining means and media for the most effective way of disseminating agricultural information. ICAR's popular journal the 'Indian Farming' was reorganised w.e.f. 1.4.1951 to make it an effective instrument for disseminating information on agricultural and animal husbandry research. A separate publicity fund to finance the

144 Reply of Minister of Information and Broadcasting Sardar Vallabhbhai Patel to *Q. No. 392 Re. 'Farm Forum Radio' for Education in Agriculture of Rural India* by Prof. N. G. Ranga, CAILD, 23.2.1948, 1046.
145 Annexure No. 44, Vide Answer to *Q. No. 503 (a), Appendix VI to HOPD, Second Session, 1952, 518-25.
remodelled ‘Indian Farming’ was also started.\textsuperscript{146} The plough is one of the most ancient tools and most valuable of man’s inventions; but long before it existed the land was in fact regularly ploughed, and continues to be thus ploughed by earthworms. It may be doubted whether there are many other animals, which have played so important a part in the history of the world, as have these lowly organized creatures.\textsuperscript{147} But did not the use of artificial manures and chemical fertilizers affect this natural plough? ‘The soil is not an inert thing; it is full of minute living creatures and plants on which we depend. Yet we spray poison wholesale over it. The death of the predators is a warning to perhaps the greatest predator of all - humankind.’\textsuperscript{148} Soil erosion was a worldwide phenomenon. "Soil erosion is the longest of all long-range problems; it must be expected everywhere and countered everywhere. Man must obey the demands of the soil or perish. International trade and international relationships must needs be such as to cry halt to soil erosion and not as in the past to invite it."\textsuperscript{149} The inter-State river valleys were to prevent soil erosion.\textsuperscript{150} Certainly, the awareness was there that many fertilizers when wrongly used could cause damage to the crop, the environment and their users. Guided by nature and tradition in carrying out their profession, nevertheless, the skill and ingenuity of the agriculturist upset the ‘balance of nature’ since agriculture largely destroyed the forest and turned to bush or grassland in recorded history.\textsuperscript{151} Agriculture, as well as research in agriculture, is altering the world for human needs. The notion of culture is derived from the Latin verb colere, i.e., cultivating the land to grow plants for consumption by humans and their domesticated animal slaves, servants and companions.\textsuperscript{152} Therefore, human history has, at least, one common and universal culture that is ‘agriculture’. The agriculturist’s is a civilising profession.

\textsuperscript{146} \textit{Annual Report of the Indian Council of Agricultural Research for} 1950-51.
\textsuperscript{147} Charles Robert Darwin (1809-1882), \textit{The Formation of Vegetable Mould Through the Action of Worms} (1881), Ch. 7.
\textsuperscript{150} Annexure No. 8, \textit{Vide Answer to Q. No. 90 (a), Re. Integrated Production Programme. Appendix IV to PD, Second Session, July-August 1950, 162-64.}
And, he gave it for his Opinion; that whoever could make two Ears of Corn, or two Blades of Grass to grow upon a Spot of Ground where only one grew before; would deserve better of Mankind, and do more essential Service to his Country, than the whole Race of Politicians put together.\footnote{Jonathan Swift, ‘A Voyage to Brobdingnag’. \textit{Gulliver's Travels}, Part 2, 119-20.}
CHAPTER – V