

# Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXV]

NOVEMBER 1937.

[No. 11.

## **Report on the work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India.**

BY SIR JOHN RUSSELL, D. Sc., F. R. S.

### **SUMMARY AND RECOMMENDATIONS**

The Imperial Council of Agricultural Research has admirably discharged its primary duty of co-ordinating and promoting agricultural research in India, at any rate in regard to crop production, with which alone this report is concerned. The Council has been able to arrange that all the factors affecting the production of each of the more important crops should be studied by one group of workers; the results can now be brought together and put into a form in which they can be used by the agricultural officers. A vast amount of pioneering work extending over a wide range has been accomplished.

A stage is now reached where a reorientation of the Council's activities should be considered.

It may be laid down as a broad principle that the investigations fostered by the Council should be for the express purpose of improving agriculture, the great need now is for fuller use of existing knowledge, rather than the accumulation of more knowledge, for work on the cultivators' fields rather than in the laboratory.

The Council's programme should, in my view, be lightened by handing over to the Universities all investigations of a scientific or non-technical nature and setting aside a certain fraction of the grant for this purpose. The grants made by the Council to Universities should be primarily for the purpose of fostering research in subjects allied or basic to agricultural science and practice and for training graduates in research methods, but the investigations should not be required to have an agricultural bearing. So far as research is concerned, it is the teacher and not the subject that counts, and the Council should be empowered to make grants to University Departments where good work is being done so as to provide one or more additional assistants who could subsequently, if needed, be attracted into the agricultural service.

Much of the research in agricultural science done in India is not as widely known as it deserves to be and I recommend the preparation of a series of monographs by competent persons setting forth the results obtained by Indian workers and pointing out how they differ from those obtained elsewhere.

Agriculture in India is not merely an industry but the mode of life of a large part of the population. The scope of the Council's work must therefore be much wider than if the subject were purely a branch of technology.

It is not sufficient for the results of the research work simply to be published in the Council Journal: the Council should have powers to undertake the much more difficult task of arranging for them to be put into practice. The Council should also act as a Development Commission, stimulating extension work by the Departments and commercial exploitation of useful discoveries. This would involve additional staff to take over various duties so as to leave the senior staff free to plan ahead and to think out the problems involved. This extension of the Council's activities would involve additional expenditure necessitating an increase in its grants.

On the other hand Provincial Departments should contribute substantially to investigations made at their Stations on subjects of importance to them.

By far the largest part of the land of India is used for producing food crops intended for home consumption. Investigations on these crops should be made in conjunction with the human nutrition experts who should advise how far existing dietaries are deficient and what supplementary crops, vegetables, fruits etc., should be grown in order to make up the deficiencies in the various regions. The Council's investigations should be directed to increasing the output per acre of foodcrops with a view both of ensuring full supplies and of liberating land for the growth of the supplementary crops and of fodder crops for the production of milk.

This increased productiveness is the main problem to which all others should be subordinated.

Investigations on quality of food crops should be made only at the request and under the close supervision of the nutrition experts except where specific marketing problems arise.

Certain problems relating to various crops should receive early attention.

*Wheat:*—In view of the fact that the export trade has fallen considerably and the home consumption increased, a decision should be reached as to the future policy. If the recapture of the export trade is proposed then vigorous steps must be taken to increase largely the area under those varieties acceptable to the modern English

market. If, on the other hand, the home market is to be the chief consideration then the varieties should be tasted for their suitability to the local mills and the making of *chapatis*, actual cooking tests being used.

*Barley*—Recent developments in the United States suggest that Californian 6-rowed barley may not be available on the English market in such large quantities as hitherto, and this may create a good opening for Indian barleys. The varieties placed high on the list by the Institute of Brewing should be grown on a sufficiently large scale to ensure adequate supplies for the development of a permanent export trade. The export of cheap barley, however, should not be encouraged owing to its high content of protein which has considerable value in India.

*Vegetables*: Every effort should be made to extend the cultivation of potatoes and other vegetables, particularly of the more hardy kinds, the list to be drawn up in conjunction with the nutrition experts.

*Fruit*. The hill regions offer considerable scope for the ordinary English and Mediterranean fruits, and the plains and the Peninsular for tropical and subtropical fruits—mangoes, citrus, bananas and others. The cultivation of fruit should be extended where possible and distinction could be made both in experimental work and in action between production for the village and production for the market. Much confusion in regard to varieties needs straightening out; methods of propagation have to be developed, and above all supplies of young trees true to type must be worked up for distribution.

Along with fruit growing for the market go various subsidiary industries, especially fruit preservation and the making of containers, besides minor activities such as bee keeping and poultry keeping, both of which go well with fruit growing.

Transport is however, a usual limiting factor and this should be improved wherever possible.

**Grass and Fodder Crops**; 1. *Grass*. The reports on nutrition lay great stress on the need for augmenting the milk supply and this resolves itself finally into an increase in the amount of grass and fodder crops available. Some 10 per cent of the livestock population have to depend on forest grazings. Various difficult problems of administration, soil erosion and deterioration of herbage are involved, and I recommend that the Council call for a report by a forester, an animal husbandry expert, and a soil expert making recommendations for improving and developing these grazings and that the council should urge upon the proper authorities the need for taking active steps to carry out these recommendations.

The other grazings, which provide for some 90 per cent. of the stock, should form the subject of a second report on which action

should be taken. They include a very wide range varying from fairly good grassland down to virtual waste land. Improvement may be possible by reseedling, selecting for this purpose varieties and strains of indigenous grasses, and introducing drought resistant varieties from Africa such as the Woolly Finger grasses, *Digitaria seriata* and *D. Pentzii*. More experiments on management are also needed: on rotational grazing, the effect of period of the year and of manuring: these all require that the land should be enclosed. Experimental work on this subject should as far as possible be done on actual grazing land.

2. *Fodder Crops.* Where water is available fodder crops can be grown and they not only provide food for the animals but indirectly increase soil fertility. Berseem is particularly useful and steps should be taken to increase the seed supply: the North-west Frontier Province appears to be a suitable source. Napier grass has done well and other fodder crops deserve investigation. The possibility of silage making should be further examined. The more intimate fusion of agriculture and livestock husbandry is one of the most hopeful ways of improving Indian agriculture.

The improvement of farm implements, and particularly of the bullock cart would reduce the need for the present large animal population and so enable the remaining animals to be better fed.

**Cash Crops.** The investigations on cash crops should be done in close association with expert users and buyers of the crops. Good example of close co-ordination are afforded by the Tea Research Institute, Tocklai, and the Cotton Research Laboratory, Matunga. Malting barley is also adequately dealt with. On the other hand the arrangements for wheat and rice are less satisfactory in neither case is the purpose of the work sufficiently definite. It is necessary to decide on the market for which the experimenters are to cater, and then to associate competent market representatives with the enquiry.

The investigations on sugarcane are on sound lines: most of this crop is used for making gur in the villages, and the experiments on the improvement of the mills and evaporating plant (including the furnace) should be pushed forward with the aid of competent engineers. Experiments on factory technique are carried out at the Harcourt-Butler Technological Institute, Cawnpore.

Broadly speaking it seems undesirable for the Council to undertake technological investigations and the new Sugar Committee could quite properly carry on this work.

Some way should be found out of the present difficulty of putting into factory practice the results obtained in the various technological investigations at the Sugar Research Institute, at Dehra Dun on forest products, and elsewhere. The difficulty in India is not so much to discover or to invent, as to exploit.

**Other Crops.** The possibility of extending cultivation of cinchona and insecticidal plants should be discussed with the scientific officers of the tea and coffee plantations, especially as the former are limiting their areas under tea as a result of trade agreements.

**Methods of increasing the output from the land.** 1. *Improved varieties.* The finding of new varieties by selection and breeding is in general very well done: it is indeed some of the best agricultural work in India. It is necessarily localised because the varieties best suited to one place may not be best suited to another: and it is continuing work because no selection can ever be final. It has now in the main passed beyond the research stage and become essentially a combination of routine operations more suited to the Provincial Departments than to the Council. Nevertheless the Council will always have an important part to play. It is the only body with full knowledge of all the material available for work on breeding or selection of crops; and it is in a position to arrange for exchange of material and to decide what work in a provincial Department should continue to be carried on if some financial stringency threatened to endanger a useful investigation.

More work is needed on the millets, the pulses, and the oil seeds.

The work would be put on to a less mechanical and more definitely scientific basis if it could be associated with a first class geneticist, good enough to command the respect of the men now engaged in the work, and to be accepted by them as a leader. Unfortunately no man of this type is at present in sight.

Improved varieties have not been widely taken up, except of sugarcane and jute partly because of the difficulty of obtaining seed. I recommend that the Council enquire into the methods of distribution adopted in the various Provinces and States, and consider the desirability of finding means for speeding it up.

2. *Better control of pests and diseases.* In general each of the more important groups of crops should have its own staff of entomologists and plant pathologists: cotton, sugarcane, the food crops, each presents special features and no one man is likely to succeed with all. Surveys should be made to ascertain which pests are increasing and which are decreasing and to collect material for ascertaining the effect of conditions on the intensity of attack. When these are known it becomes possible to see how far changes in conditions or methods will obviate the attack. Direct control by chemical means is sometimes the only possible method, and the work on vegetable insecticides should be continued with some modification of programme. Biological control presents various difficulties, but should be studied.

In view of the importance of insect pests in India, and the need for finding means of control, I recommend that a visiting expert of

high standing be called in to advise as to the most suitable types of measures to be taken.

The search for resistant varieties must always continue, it is more useful for fungus diseases than for insect pests and in any case it is not final: so called "resistance" often means only that another variety growing close by is preferred; and even actual resistance may break down.

It is very important, however that some central authority should have power to deal administratively with plant diseases and pests for the whole of India. With increased speed of transport it is almost impossible to keep out disease organisms from other countries but it is far easier to deal with an invader at an early stage than to wait until it has spread into every Province.

The Council, however should not be concerned with the executive control of diseases and pests: its duties should be to arrange for research and advice into the most suitable means of dealing with them.

3. *Improvement of the water supply for crops.* This is one of the most important of all agricultural problems in India and perhaps the most difficult. It is too big to form part of a programme, and I recommend the establishment of a Central Irrigation Station for all-India where the agricultural problems can be worked out. At this station the relations of soils, water and growing crops would be studied, also the interaction between salt water and soil, the reclamation of salted and alkaline land, the movements of subsoil water, and the agricultural effects of various sequences of crops.

Provision should also be made for more complete co-ordination of the investigations on dry farming and for linking it up with the work of the proposed Irrigation Research Station.

4. *The Conservating of Soil Fertility.* (a) *The prevention of erosion.* While further research on soil erosion should continue, the chief need now is for action rather than for more research. Protection against erosion should be State responsibility and each erosion area should be dealt with as a whole. An Erosion Conference should be held annually at which forestry, animal husbandry and soil experts meet the agricultural officers and advise as to what measures should be taken; the appropriate Minister should then have power to carry out these measures and to distribute the cost over the lands protected.

(b) *Manuring.* More systematic schemes of manurial trials are necessary in order to test the relative values of nitrogen in artificial fertilizers, farm yard manure and composts, and the values of phosphate and potash. Simplified schemes should be carried out on cultivators' ground so as to discover what new factors, if any, come

into play there and to find also how far the stations results hold generally.

Green manuring should be more systematically studied.

A report on the manurial trials fostered by the Council should be drawn up by the Statistician, with recommendations for a more systematic treatment. If they can be obtained, the results of the extensive trials carried out recently by the large fertilizer organisations (Imperial Chemical Industries : the Potash Syndicate) should be included in the survey.

Next to an improved water supply an increased supply of farmyard manure should probably do more than anything else to augment the output from the land. Additional supplies of fodder crops would add to the amount of farmyard manure, but the surest way of doing this is to reduce the necessity for burning it by providing alternative sources of fuel. The Forest Department should be consulted as to suitable ways of planting tree belts that could provide shelter, fodder and fuel, and protection against erosion and dust storms.

**The Special Difficulties of Indian Agriculture.** One of the most serious defects of Indian village life is the absence of an educated middle class actually engaged in farming. Students from Agricultural colleges, who might be expected to form this class, do not take to farming, but strong efforts should be made to induce them to do so. The experiment of establishing Colony villages in the canal areas of the United Provinces seems to offer one method of solving the problem. Generally speaking specialised farming such as cotton growing, fruit farming, seed production, etc., afford better prospects for a trained man than ordinary farming.

The Co-operative movement can hardly be expected to achieve as good results as in Denmark owing to the wide difference in conditions. The experience of Bombay and the Punjab is, however, that something can be achieved if there is firm guidance from outside, and probably suitable modifications in this direction can be devised.

The consolidation of scattered and fragmented holdings is so important that officers found to be successful in arranging it should be encouraged to remain at the work and should not be under the necessity of seeking advancement in other directions.

Owing to the importance of fruit and vegetable growing in the villages, and the desirability of planting more trees, school teachers should be encouraged to take up gardening and to undertake some of this planting with the children. Where possible, a school garden should be established.

The insufficiency of subsidiary industries is a well recognised weakness of Indian village life : the cultivator has long slack periods during which, if he had the opportunity, he might be increasing his

income. An expansion of the cropping scheme should be arranged to utilise some of this time. Poultry keeping offers some possibility of success over a wide area as shown by the results of Mr. A. E. Slater in the United Provinces and of Dr. Hatch at Martandam in Travancore ; beekeeping is possible in the hill regions. The ideal occupation would be cottage industries but apart from weaving and a few localised industries, these are hampered by the very difficult problems of marketing.

**Bridging the Gap between the Experiment Station and the Cultivator.** By far the most important and most difficult task before the agricultural officers in India is to bridge the great gulf separating the agricultural experiment stations and the few large scale farmers from the peasants who cultivate by far the largest proportion of the land. It is not new science so much as fuller use of existing science that is needed, and the Council should order an enquiry to discover how best this could be done and to urge upon the proper authorities the need for taking all steps possible to this end. The extension officer should be recognised as a very important member of the staff and really competent men should be encouraged to continue at the work and be under no necessity to seek promotion out of it. The possibilities of broadcasting should be tested and means should be devised for the rapid answering of enquiries that have come in as a result of the talks. It should be impressed upon the staffs at the experiment Stations that they have a responsibility to the cultivator ; that they must not shelter themselves within the walls of the laboratory in the hope that somehow their work may find practical application; they must make the field and the crop their centres, and as early as possible set out experiments on cultivators' land so as to widen the scope of their enquiry.

Demonstrations should be made by means of holdings taken as a whole in addition to those on individual plots, and the staffs of the experiment stations should be expected to carry out simplified forms of their experiments on cultivators' land unless there was good reason to the contrary.

**The Imperial Agricultural Research Institute, Delhi.** The Institute both because of its tradition and in virtue of its equipment should take a leading part in agricultural research in India. It can best accomplish this by working in close collaboration with the Imperial Council of Agricultural Research which, as the actual agent for the co-ordination of agricultural research in India, should be in a position to require the inclusion of specified items in its programme of work. Among other important subjects which could be handed over to the Institute are the devising of statistically sound methods of sampling soils and crops for approximate and accurate investigations

respectively ; the collection and collation of the results of the numerous local soil surveys that have been made ; surveys of insect and fungus pests and of physiological and other diseases. In carrying out its own programme the Institute should carefully avoid the common faults of keeping the work too much in the laboratory ; it should centre its investigations on the field and it should study a few problems thoroughly rather than a larger number superficially.

**The Staff.** Suggestions are made in regard to training and qualifications of staff, and the difficulty of finding good leaders is emphasised. Good officers who excel in either research, extension work, or in persuading cultivators to consolidate their holdings, should be kept at their work and should not be compelled to seek promotion outside of the sphere in which they have proved their capacity for success. Although the Council's schemes are by their nature temporary the research staff should after a probationary period be given certain advantages of permanence ; in particular a provident fund scheme should be set up for them, a register of competent workers should be maintained so as to help the men to find other posts, and a permanent cadre of selected workers of proved merit should be formed for the purposes of carrying out investigations wherever this might be necessary.

**The Improvement of the Village.** The efforts to improve agriculture are likely to be unavailing unless the villages are improved and made fit for good cultivators to live in. This work has a deep personal side and could never be accomplished without enthusiasm and the missionary spirit ; but it needs a solid foundation of accurately determined knowledge, and careful impartial consideration of the probable effects of proposed measures. The Council could probably better than any other body arrange for this to be done by organising surveys or other enquiries.

It should also arrange for a Report on methods of effecting consolidation of holdings and of cropping, and consider what steps could be taken to hasten these changes.

**General Recommendations.** (The detailed recommendations relating to the research schemes are given under each section).

1. The success of the Council's efforts shows that its general organisation and research programme are both sound and that it is a very effective agent for the improvement of Indian Agriculture. My proposals are for an extension of its activities but always with the same purpose ; increased production from the soil of India.

2. An organised research scheme implies a definite plan for agricultural improvement and means of ensuring that the results of the research work are put into practice. I recommend therefore that the powers of the Council be widened to comprise developmental activities as well as research activities.

3. The work on crops sold in the open market (cash crops) should be done in association with the expert buyers or users of the crop. As a crop becomes of sufficient importance it should have its own committee and specialist staff as now happens for cotton and jute and will soon be the case for sugar.

4. The work on crops mainly retained for food (food crops) should be done in association with the nutrition experts, who should advise as to the most suitable means of making up deficiencies in diet. The Council on its Developmental side should arrange for the recommendations to be put into practicable form. A survey showing broadly the quantities of food produced in the various provinces should be made so as to provide a basis for joint action by agriculturists and nutrition experts in improving the schemes of food production in the villages. The newly appointed liaison officer between the Agricultural and the Health (nutritional) departments could be of a material assistance in this work.

Fodder and grazing committee should be set up for each Province so as to examine the possibility of increasing the food supply for animals.

5. Part of the Council's funds should be used for promoting scientific research at the Universities on subjects basic to the science and practice of Agriculture. This financial aid however should be essentially personal, it should be given only to enable an investigator of proved capacity to develop further his own main line of research. No question of possible practical value should be raised; in training for research it is the man and not the subject that matters.

6. On its developmental side the Council should have resources:-

- (1) to put into practical form the dietetic recommendations of the nutrition experts;
- (2) to stimulate activities directed to the bridging of the gap between the experiment station and the cultivator;
- (3) to plan extensions of dairy husbandry, fruit and vegetable growing, poultry keeping and other specialised branches of agricultural production in relation to transport and marketing facilities and to co-operate with the Departments in putting them into practice;
- (4) to arrange for the setting up of organisations for the multiplication and distribution of approved stocks of seed, sets and fruit trees;
- (5) to advise the Government in regard to other action that could usefully be taken for the improvement of agriculture or the avoidance of some impending loss of soil, crop or market;

- (6) to arrange for the exploitation of results of commercial interest obtained at the research stations, e. g. the conserving of fruit and vegetables.

7. The Council should set up a Soil Conservation Committee whose functions would be :—

- (1) to arrange for the collection and collation of results of manurial trials and for the putting into practice of suitable results; the co-operation of the experimental staff of the large fertilizer organisations being if possible secured for this purpose;
- (2) to watch closely regions liable to erosion calling periodical conferences of the Departments concerned, with a view to working out schemes based on the physical rather than the political boundaries;
- (3) to arrange for the collection of results of soil analyses and the accumulation of material for a soil map of India;
- (4) to help Departments where necessary in making surveys in irrigated regions or wherever salt or alkali may cause trouble so as to ascertain whether or not it is spreading; to arrange also for reclamation of deteriorated soils;
- (5) to examine the cultivable waste lands and report how far they can be better utilized.

8. The Council should call for a report by an agrostologist, a forester, an animal husbandry expert and a soil expert, under the chairmanship of the Agricultural Expert to the Council, on the grazings available in each Province and on the methods of improving them; it should then encourage appropriate action.

9. The Council should set up a Crop production Committee whose function should be :—

- (1) the consideration of the cropping schemes, much on the lines adopted by the Crop Planning Conference, with a view to advising about desirable extensions or curtailments of areas under particular crops, improved sequences or rotations, fodder crops, etc;
- (2) the general oversight of the programme of research work on crops and examination of the results; the framing of schemes for putting accepted results into practice;
- (3) the organisation of watching services to report on the incidence of insect and fungus pests, noxious weeds or other threats to crop production and to arrange for the working out of control measures with the help of some visiting expert if necessary. The Council would then advise the Government as to any steps that should be taken.

10. In view of the supreme importance of water to the growing crops I recommend the establishment of a separate Research Institute for the study of irrigation and water relationships to soils and crops; also of more unified direction of the work on dry farming.

11. None of these proposals can attain much success unless the standard of country life is raised and this necessitates the settlement of more educated men and women on the land. An enquiry should be made as to the working of the various colonisation and settlements experiments in the Punjab, the United Provinces, and elsewhere and steps taken to institute large scale trials of promising methods. The influence of a colony of good cultivators on the surrounding district would be out of all proportion to their number.

12. The machinery at the disposal of the Council for carrying out this work should consist of :—

(a) the Imperial Agricultural Research Institute, Delhi which should work in close co-operation with the Council, and whose programme would largely be determined by the problems confronting the Council :

(b) A Marketing branch ;

(c) a cadre of proved investigators, selected gradually from among the temporary staff now engaged on the Council's schemes ; these men would be sent to various stations to deal with difficult problems for which the local resources were inadequate ;

(d) a staff of temporary investigators as at present. I recommend, however, that their status be improved by setting up a Provident Fund and by establishing a register of approved persons which should be available to Departments, organisations or private employers wanting scientific workers.

13. These recommendations if carried into effect will necessitate an increase in the grant made to the Council. I see, however, no alternative to the acceptance of this situation. The Council is the co-ordinating agency which provides invaluable assistance to the Provincial Agricultural Departments and will afford still greater help if it is given the wider developmental powers that will enable it to bring to fruition investigations which at present stop at the experimental stage. These departments between them spend over 200 lakhs of rupees annually, a large sum and yet it amounts to little more than one anna per acre sown. The Council's regular grant of 5 lakhs is augmented for various purposes but its income is in my view inadequate for this its important duties and the need for additions to its resources should be recognised at any rate for the next few years, if progress is to be made as rapidly as desired.