Inauguration
of
National Symposium on "Inter and Multiple Cropping of Short Duration Varieties of Pulses for a Major Advance in the Production of Biological Nitrogen and Protein Resources"

August 13, 1974

12.00 Noon

at the Indian Agricultural Research Institute, New Delhi.

Inaugural Address
of
Shri C. Subramaniam
Minister of Agriculture.

Dr. Swaminathan, Dr. Joshi and Friends:

I am glad to find that the Indian Society of Genetics and Plant Breeding has thought of organising this Symposium. The theme of the Symposium is of very great interest in the context of our present-day problems of agricultural production. There is a world-wide shortage of chemical fertilisers following the energy and the petroleum products crisis. Countries like India, which in recent years have embarked on large scale programmes of scientific upgrading of their agriculture, have been more severely affected by these shortages than many of the developed countries.

2. As you all know, the high yielding varieties programme, which constitutes our major strategy for increasing agricultural production, was started less than 10 years ago. The success of this programme and the logic behind it can hardly be questioned. During this brief period, it has been possible for us to double the production of wheat: there were also significant increases in the production of some of the other crops including maize and bajra. The significance of this major production advance resulting from the high yielding varieties programme should not be minimised. We must remember that the severe drought in many parts of India, particularly in Maharashtra, Gujarat and Andhra Pradesh, during the last three years, would have proved disasterous, had our wheat production continued to stay at the level of 12 million tons, the highest ever recorded before the

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release of the high yielding varieties seven years ago. The production of wheat in spite of adverse climatic conditions and shortage of fertilisers has continued to be of the order of 24 to 26 million tons. The total production of food grains during this period has been over 100 million tons while it was only 76 million tons during the earlier drought period of 1965-66.

3. In view of these solid gains, there is no justification for the doubts which are some times expressed about the feasibility of the strategy based on the high yielding varieties programme. The question which we must now ask is how this strategy can be extended to other crops like rice, sorghum, pulses and oilseeds so that the programme is more broad-based and our agricultural production augmented more uniformly. A second important question relates to the role of chemical fertilisers in these programmes, because of the shortages with which we are faced at present.

4. It is now fully recognised that along with seeds of the high yielding varieties, chemical fertilisers have a key role in increasing agricultural production. It is believed that unless the agricultural scientists are able to score a major scientific breakthrough in the field of crop production - and this may take 40 to 50 years - there can be no substitute for chemical fertilisers in agricultural production. We must, therefore, make all possible efforts to increase the production of chemical fertilisers in the shortest possible time. However, even with the best of efforts, it will take many years before we are able to meet

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our total requirement of chemical fertilisers. This requirement is expected to be of the order of 8 million tons by the end of Fifth Five Year Plan. I may recall here that, the average quantity of chemical fertilisers used in India is only about 12 Kg per hectare per year while it is more than 200 Kg in countries like Japan.

5. In the context of this fertiliser shortage, pulses have the most important role to play in our agriculture. Pulses have been the mainstay of Indian agriculture for thousands of years. They are potentially the most important source of protein in the average Indian diet and for this reason alone, they should receive far greater attention both in research and development programmes than they have done in the past. It is not widely recognised that pulses have also made a most important contribution in maintaining the fertility of Indian soils, which have been continuously cropped for thousands of years without application of chemical fertilisers. It is the nitrogen fixed by the legumes, which has been the main source of restoration of soil fertility in India. It has been estimated that nearly 90 million tons of nitrogen are fixed, in the world as a whole, through the biological activity of bacteria, algae and other organisms. This amount is nearly 4 times the total production of chemical fertilisers throughout the world. In no other country the biological fixation of nitrogen has been a more important source of soil fertility than in India. This is because in no other

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country pulses have such an important place in human diet and in cropping systems than in India.

6. The important place of pulses in our agriculture, going back to thousands of years, has obviously been determined by natural selection both in the human populations as well as in the populations of our crop plants. The point, which I would like to emphasise at the present moment, is that what our forefathers did in domesticating the pulses and in fitting them as an important component of our agriculture, we, with our present scientific knowledge, can do more efficiently and effectively. The most important requirement is to see that pulses are fitted to a greater extent in inter and multiple cropping patterns than in the past. I hope the participants in this Symposium will identify these inter - and multiple cropping patterns and help in formulating a major developmental programme in this direction in each of our States. I have been told that it should be possible to produce nearly half a million ton of additional nitrogen during the next few years through the biological activity of bacteria associated with the pulses, if more effective inter - and multiple cropping patterns can be introduced in our farming systems.

7. These cropping patterns would also, of course, make an important contribution in increasing the production of pulses. It may not be possible to find

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additional land for extending the area under pulses. However, additional cultivation is possible if pulses can be fitted in the different cropping patterns, without displacing any of the existing crops.

8. The cheapest and perhaps the most effective way of increasing the production of biological nitrogen would be to make more efficient use of Rhizobium cultures in our pulse production programmes. It costs only five Rupees per acre to combine the cultivation of pulses with the application of recommended Rhizobial cultures. Fortunately, our scientists have been able to identify and multiply Rhizobium cultures which are as good as those available in any other country. I am, therefore, not very clear why the use of Rhizobial cultures has not been as widely practised by our farmers as it deserves to be adopted. It is possible that a major factor responsible for this is that while we have good Rhizobium cultures, our methods of quality control are not as good as those in some of the other countries like the U.S.A. There is a definite need to ensure both the purity and the self-life of the cultures over long periods, and a programme of independent quality control needs to be developed in this regard. This has become all the more important because, a number of private organisations have started producing Rhizobial cultures on a mass scale. This is a welcome development and I think it will be in the interest of all of us if a quality control unit which is independent of the producer organisations is set up. I make this suggestion

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because I remain convinced that we have not made full use of the opportunities which Rhizobium cultures offer for increasing the fixation of atmospheric nitrogen in our soils and for increasing the production of pulses and other crops in this manner.

9. Another important question before us is whether the available quantity of fertiliser can be more efficiently used keeping in view the world-wide shortage of these nutrients. As we all know, the leaching and other losses of chemical fertilisers are very large. This Institute has done some work in the field of fertiliser use-efficiency and a number of measures have been suggested. These include recommending fertiliser doses on the basis of soil test values, more efficient irrigation techniques, control of weeds, suitable placement techniques and use of denitrification inhibitors in order to reduce some of the losses. I am particularly interested in this latter technology. The time has now come when this technology should be tested on farmers' fields. If it can be successfully translated on farmers' fields, we can achieve a tremendous saving on our present resources of chemical fertilisers. There is also an obvious need to intensity research in this important area. The programme of National Demonstrations to popularise the seeds of high yielding varieties has already proved highly successful. The scope of this programme of National Demonstrations on farmers'

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fields should be extended to cover other production techniques, such as getting the best out of the fertiliser applied.

10. Our scientists and agricultural administrators should analyse why the high yielding varieties programme has been more successful in wheat than in some of the other crops like sorghum and rice.

11. Sorghum is one of our most important food grains, and in terms of area, it has a place next only to rice on a national basis. In sorghum, high yielding hybrids and varieties were released at about the same time as in wheat and I have been told that these high yielding varieties and hybrids compare in their productivity with some of the best in the world. However, in spite of the availability of these varieties for nearly ten years, sorghum production in States like Maharashtra and Andhra Pradesh has not seen a significant increase. There may be several reasons for this but I shall draw your attention to one of the more important of them. It is well-known that, unlike wheat, the sorghum crop is far more susceptible to damage by insect pests. In fact many people believe that the major reason for the failure of sorghum production arises from our inability to protect this crop against insect pest damage. There are also, of course, other factors such as the shortage of hybrid

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seed and the non-irrigated nature of this crop. There is, however, little doubt that damage by insect pests is one of the most important factors for the low yields of sorghum hybrids in farmers' fields. A few of the farmers who have the means to adopt plant protection technology have been able to raise very good crops. Most of the small farmers however have failed to do so.

12. Our failure to increase production of sorghum should draw our attention to one of the weaknesses of our present developmental programme in agriculture. The high yielding varieties programme in many crops has not received as much support as was needed in the fields of crop protection, soil and water management and other improved practices. We should review our national policy in these fields. I like to illustrate this by taking the example of the plant protection programmes.

13. The organisational structure which exists in our state departments of agriculture, as far as plant protection work is concerned, was laid down many years ago when agriculture in this country was almost entirely traditional. In this kind of agriculture, there was not much need for intensive plant protection programmes. The major objective of such agriculture was to obtain some yields with the minimum possible investment in the form of inputs. When a new and a very different strategy was adopted ten years ago with the introduction of the Intensive Agricultural District

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Programme and subsequently the High Yielding Varieties Programme, plant protection became an input of very great significance. It was clear from the very beginning that the High Yielding Varieties Programme will not succeed fully, unless it provided for a number of inputs including fertilizer, irrigation and plant protection. Fortunately, in the case of wheat, the package of practices is not very large, as the crop is raised under very stable environmental conditions, when pests are not a major problem. However, in most of our kharif crops including sorghum and rice, the package of practices has to be larger, and unless it includes effective plant protection measures it may not succeed. This raises the question whether the existing organisation of plant protection work in our departments of agriculture should not be reviewed and strengthened greatly. There is a need to evolve new organisational patterns taking into consideration the changed agricultural situation. The main object of this review should be to ensure timely availability of plant protection measures to all our farmers, large and small.

14. We already have high yielding varieties in a number of crop plants including wheat, rice, sorghum, bajra and maize. As far as other crops like pulses and oilseeds are concerned, I am clear in my mind that high yielding varieties in these crops can also be developed and will be developed within a short period. I have talked to many

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scientists in this regard and most of them feel that there are no scientific reasons why high yielding varieties similar to those in cereals cannot be developed in these crops. Pulses and oilseeds, unlike the cereals, have been grown for centuries under marginal conditions of moisture stress. Under such conditions, natural selection tends to have the upper hand; it has given us varieties which are well adapted to poor conditions of cultivation, but which have lost the genes and can take advantage of improved conditions of crop management. Our major task in the years to come should be to bring together these genes, which may now be dispersed in isolated populations in different parts of the world. A major contribution in this direction will be made by our ability to make collection of seeds of pulses and oilseed crops from different parts of the world and also, of course, from our own country. If we can make it possible for our plant breeders to collect seeds of pulses and oilseeds from different parts of the world, the speed of their improvement programmes will be greatly accelerated.

15. It should be possible for our scientists to organise genetic collection teams for going to different countries and obtain valuable materials. I find that scientists from Japan, USSR and USA have been organising exploratory organisations of this kind to different parts of the world. A country like India, whose economy is so heavily dependent

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on agriculture, should assume leadership in organising collection trips of this kind. We are thinking of setting up a new Organisation in the form of a Plant Introduction Bureau during the Fifth Five Year Plan, which would help to meet this very important requirement of our plant breeders all over the country.

16. I am quite sure that with the availability of new genetic variability, high yielding varieties of pulses will be increasingly available. Some progress has already been made in this direction during the last six years. A number of short duration varieties have been developed and released, in crops like red gram and green gram; these are finding an important place in our multiple and inter-cropping patterns. In this connection, I would like to refer to some very encouraging results which have been achieved in the State of Madhya Pradesh and elsewhere in the course of developmental programmes on pulses. In Madhya Pradesh, a programme of this kind on Bengal gram during the last four years has resulted in additional production of nearly half a million ton. The main component of this programme has been the application of phosphatic fertilizer and the control of insect pests through the application of pesticides. There are now clear indications that if this production programme in Madhya Pradesh is extended, the gains would be considerably greater in the years to come. In some of the Southern and Eastern States the short duration varieties

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of green gram have found an important place in paddy-fallows and in other cropping patterns. It should be possible for us to earmark some quantities of phosphatic fertilizer and pesticide for these production programmes. What is even more important is an organisational set up, which would make sure that these inputs reach the farmers without delay; I see a very important role for our extension agencies in this regard. The Madhya Pradesh experiment in increasing pulse production has a significance which should not be overlooked. Our efforts at this stage should be to see how the scope of programmes of this kind can be extended.

17. I am happy to inaugurate this Symposium and I do so in the hope that your deliberations will pave the way for a marked increase in the area under inter-cropping and multiple-cropping of pulses. I would also expect you to draw attention to the organisational and other constraints, which must be removed for the success of such a programme.

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(Material for the lecture of Sh.C. Subramaniam)

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## The lessons of the new strategy of agricultural transformation evolved in India

C. Subramaniam

There is world wide interest today in the changes taking place in India in the agrarian scene. Even diehard economists refer to the storm of change now sweeping one of the oldest and deep-rotted citadels of subsistence farming as a 'miracle'. The change in the outlook of the farming community is sudden but is based on mature considerations arising from a conviction that the change provides the only hope for a prosperous life. Before considering how this change occurred, I would like to give a brief outline of the food situation in India during the last 100 years and also provide some basic data concerning Indian agriculture.

1. Food scarcity:

Many years ago, Mahatma Gandhi said that 'if God were to appear in India, He would have to take the form of a loaf of bread'. It is ironical that India which enjoyed a great reputation in Europe as early as the 17th Century since early times for some of its outstanding plant products such as spices and for its excellent textiles, has during the last century had to face many famines. During the reign of the East India Company, severe famines occurred in the years 1770, 1784, 1802, 1824 and 1837. After the administration of the country was taken over by the British Government from the East India Company, great famines occurred in North West India in 1860, in Orissa in 1865, in Rajasthan in 1868, in Bihar in 1873 and in South India in 1876. Two widespread famines occurred in the entire country in 1896 and 1899. The Orissa-Bengal famine of 1865 to 1867 affected nearly 50 million people. Following the famine of 1876, a Famine Commission presided over by Sir Richard Strachey was appointed. Since then, many Famine Commissions have followed. The Agricultural Department in India itself was

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established following the report of the first Famine Commission. I am mentioning all these historical details only to remind you of the fact that there have been occasional scarcity of foodgrains in the past as even before our agriculture had remained stagnant over a long period of time and consequently, there was not enough food whenever the weather conditions were not favourable for crop growth. Our agricultural production remained entirely dependent upon natural factors.

2. Problems of Indian Agriculture:

Land Resources: The total geographical area of India is about 326.8 million hectares of which about 137.8 million hectares or 42 percent was under cultivation in 1964-65. The gross cropped area in 1964-65 was 158 million hectares. The acreages under principal crops are given in Table. The cropping intensity for the country is about 115 per cent. Even on irrigated lands the cropping intensity is only about 117. A close study and analysis of the situation reveal that the reasons for low intensity of cropping are:

i) Provision of irrigation facilities as a means of protection against drought rather than as a means of intensive cultivation;

ii) Cultivation of long duration varieties of crops by cultivators which mature by the time when even the moisture provided by late rains cannot be available for the subsequent crop;

iii) Adoption of the age-old practices by cultivators of leaving the land fallow after one crop to enable it to recuperate the fertility and non-utilisation of fertilizers as well as compost etc. on a large scale.

Sub-division and fragmentation of holdings had been increasing due to prevalent laws of inheritance, growing pressure of population and inadequate development of industry and trade etc. and this factor has produced adverse effects on productivity of land. Uncontrolled grazing, absence of systematic efforts to check soil erosion, spread of desert, formation of ravines and gullies in vast areas of the country have also caused deterioration in land resources and their productivity.

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Erosion, Salinity and other problems: Soil erosion is a serious problem. About 80 million hectares require early attention mainly in Peninsular India, Central India Plateau and Deccan Plateau and Himalayan and Sub-Himalayan region in Punjab, Uttar Pradesh, Jammu and Kashmir and Himachal Pradesh and Rajasthan and parts of Orissa, West Bengal and Assam. In the irrigated areas, water logging, soil salinity and alkali conditions are posing a serious problem. The problem area is estimated at about 4 million hectares of saline and alkali soils and about 2.4 million hectares of coastal saline lands and about 1.2 million hectares of actual water logged land. About 2.4 million hectares of area are covered by ravines. Out of this only a limited area can be used for agricultural purposes but the rest can be used for the development of fodder and timber.

Shifting cultivation is also a serious problem notably in parts of Assam, Manipur, Tripura, Orissa, Madhya Pradesh, Andhra Pradesh and Maharasthra. It is estimated that in 1956, shifting cultivation was practised over 0.55 million hectares. However, the total area damaged was many times more. In Orissa alone 3.24 million hectares are estimated to be affected by shifting cultivation. The problem is more acute in tribal areas. However, gradually the desirability for stabilised cultivation is being realised and technical and financial help for introducing bunding, use of fertilizers, etc. is being given to promote stabilised cultivation.

Land Reclamation: During the last 16 years, measures were taken by the Central and State Governments to undertake reclamation of waste lands. Waste lands were also distributed to the landless agricultural workers and they were helped to cultivate them. The total area reclaimed between 1951-52 and 1965-66 was 3.5 million hectares.

Vast areas of saline, alkaline and ravine lands in India require reclamation, However, the investment needs for all areas are prohibitive and a beginning is being made to save marginal lands threatened by formation of ravines. Heavy earth moving equipment, crawler tractors and such other machinery are required to be employed on large scale for many of the projects. At present, mainly due to scarcity of foreign

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Soil and Water Conservation: Our Country has vast problems of soil and water conservation, States like Maharashtra and patts of Mysore, Andhra Pradesh, Gujarat, Madhya Pradesh and Orissa where rainfall is below 30 inches per year and irrigation from surface water or ground-water resources is not possible, moisture conservation is extremely important for the productivity of the soil. During the Second and Third Plan periods the interest of State Governments in soil conservation measures has been greatly aroused. In building up Soil Conservation Organisation, enactment of suitable enabling legislation, training of personnel, demonstrations, research and soil and land-use surveys, certain valuable advances have been made. The extent of agricultural lands benefitted by bunding and other soil conservation measures was 1.3 million hectares during the first two Plans and 3.8 million hectares under the Third Plan. In the catchment areas of major River Valley Projects, special programmes of soil and water conservation have been taken up. The scope of all these efforts is being widened during the current Plan.

Irrigation and Drainage: Certain problems faced by India in the matter of irrigation development deserve mention. Creation of irrigation potential moved faster than its utilisation. Mainly in respect of major irrigtion works, the potential was not utilised because in several areas, distributories and field channels were not completed by the time of release of water in canals. Further, adequate planning was not done for dealing with problems of land levelling and development,

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reshaping of fields, evolving new cropping patterns, undertaking arrangements for training the farmers in wet cultivation practices, provision of roads and communications, credit and new inputs in the command areas. At the end of the First Plan the percentage of utilisation of irrigation potential was 48. During the Second Plan also, there were lags in utilisation. Since the beginning of Third Plan, increasing attention has been given to the utilisation of irrigation potential and in 1965-66 about 80 percent of the irrigation potential is reported to have been utilised. Special Ayacut (Irrigation Commant Area) Development Programme now constitute an important part of the Fourth Plan. Effective action calls for synchronisation of various activities, enactment of supporting legislation and various other institutional and financial arrangements.

Another important aspect of irrigation is that coordinated development of surface water and ground-water resources is desirable from the long-term interest of agricultural development.

Increasing problems of water logging in irrigated areas, salinity and alkalinity have stressed the urgent need for integrated planning of irrigation and drainage. In India, several Master Plans have been prepared/or being prepared for such integrated planning. A Water Utilisation Cell has also been set-up by the Government of India for evolving and propagating an integrated scientific approach to problems of water use and management so as to get the maximum advantage from water and avoid damages to soils. Much of the salinity and alkalinity problems to which I made a reference earlier are the result of the absence of such an integrated approach during the last 100 years when arrangements for irrigation were made without a coincident attention to drainage problems.

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Organic matter: The ~~lack~~ of organic matter in the tropical soils due to the high summer temperatures and soil erosion is a serious limiting factor in increasing soil fertility. Most organic wastes are currently utilised as fuel and the ultimate solution to this problem is the availability of cheap electric power. A Biogas plant was evolved over 30 years ago at the Indian Agricultural Research Institute, New Delhi for the twin purposes of conserving organic matter and providing fuel but its spread has been rather limited largely due to the low production of gas during the winter months in North India as a result of poor microbial activity.

Planned Agricultural Development

(Material for the lecture of Sh.C. Subramaniam)

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Increasing problems of water logging in irrigated areas, salinity and alkalinity have stressed the urgent need for integrated planning of irrigation and drainage. In India number of Master Plans have been prepared/or being prepared for such integrated planning. A Water Utilisation Cell has also been set-up by the Government of India for evolving and propagating scientific approach to problems of water use and management so as to get maximum advantage from crops and avoid damages to soils.

## Regrganisation of Agricultural Research

Reviews of the agricultural research work in progress in our country have been made periodically by various scientific teams. From time to time, certain improvements had been introduced into the working of the Indian Council of Agricultural Research on the basis of the suggestions made by such teams, which have all felt that I.C.A.R. should become an effective instrument for coordinating research on agriculture and animal husbandry in the country. These changes, however, had only a marginal effect in achieving an effective coordination of research and integration of work in the different scientific disciplines. The last Research Review Team led by Dr. Marion Parker of the U.S. department of Agriculture in its report submitted in 1965, therefore, suggested more fundamental alterations in the structure and scope of activities of the Indian Council of Agricultural Research. This team wanted to achieve two main purposes. First, the research work in progress under (a) what are currently termed as the subordinate offices of the Department of Agriculture which include s institutes like the Indian Agricultural Research Institute, the Indian Veterinary Research Institute and the National Dairy Research Institute, (b) PIRRCOM centres and certain other institutes directly managed by the I.C.A.R. (c) Commodity Institutes like those on jute, arecanut, coconut, tobacco, etc., managed by separate Commodity Committees, (d) Agricultural Universities, and (e) State Government should all become part of an integrated set-up and should become instilled with a sense of common purpose. Secondly, the administrative and organisational structure of the I.C.A.R. should be modified in suh a way that the administrative part of the machinery becomes subservient to the scientific and technical part. In other words, I.C.A.R. should become an effective scientific body so that it could provide the leadership necessary for stimulating major research break-throughs.

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2. During the last three years, we have been actively engaged in taking the steps needed to implement these important suggestions and bring into existence a 'new' I.C.A.R. The changes went through the following steps. Following the approval of the Cabinet of the reorganisation proposals, we appointed an eminent scientist as the Director-General of the I.C.A.R., thereby replacing the tradition that such a post is tobe occupied only by an administrator. Secondly, we proceeded with the dissoultion of the various Commodity Committees and transferred the control of the research Institutes run by them to the ICAR. Thirdly we arranged forthe effective technical supervision of the work in progress at such of the PIRMCOM Centres which couldnot be amalgamated with theState research Institutions, by placing these centres under the technical control of the I.A.R. I. Fourthly, we transferred the Section in the Department of Agriculture ~~xxxxx~~ dealing with the centrally-run institutes to the control of the Indian Council of Agricultural Research. When this process is finally completed, we should have a well knit and unified research organisation which brings within one frame institutes which were formerly under diverse administrative and technical authorities.

3. Having attempted to set our own house in order, we gave thought to the problem of more actie and effective relationship between State, University and ICAR research Institutions. For this purpose we have formulated a series of All-India Coordinated Projects in twenty major crops of the cantry. These projects were drawn up by groups of scientists endowed with expert knowledge in the crops concerned. These All-India Coordinated Projects will all be implemented duringthe Fourth Plan and they envisage the setting up of many regional stations in the different States. These stations will be under the administrative control of the States concerned but will be subject to an over-all technical coordination. The day-to-day coordination work will be discharged by whole-time Project Coordinators who will be scientists with outstanding records of service. For ensuring the smooth functioning of these projects, a Memorandum of Understanding has been drawn up for being executed

by the I.C.A.R. and the States concerned. This Memorandum would help to facilitate more close cooperation among the personnel employed in an All-India Research Project, irrespective of their location. Thus, the base for a really integrated and coordinated attack on agricultural problems and for conducting adaptive research has been laid.

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Agricultural Education

A brief idea of the agricultural education facilities at various levels is provided in Table:

| Institutions | 1955-56 | | 1965-66 | |
|---|---|---|---|---|
| | No. of Institutions | Personnel trained per year | No.of Institutions | Personnel trained per year |
| Agricultural Universities | - | - | 8 | 1531 B.Sc.Ag.<br>367 M.Sc." |
| Post-graduate Institutions for Agriculture | 8 | 141 | 36 | 1091* |
| Agricultural Colleges for degree | 31 | 886 | 72 | 5259* |
| Veterinary Colleges (Post-Graduate). | 4 | 36 | 12 | 128* |
| Veterinary Colleges for degree | 14 | 268 | 20 | 990* |

* Include the personnel trained in Agricultural Universities

Considerable expansion in graduate and post-graduate training has taken place in India during post-indpendence period. Development of Agricultural Universities on the model of the U.S. Land Grant Colleges to meet the requirements of higher agricultural education needs special mention. Short-term training of farmers in improved agricultural practices is also making progress. However, effective arrangements for vocational education in agriculture have not been made adequately so far

Extension

India started National Extension Service in 1953. In 1966-67, in all the States of India, the number of various categories of extension personnel employed upto the level of Blocks ( of about 100 villages each) was as under:

| | No.(thousands) |
|---|---|
| 1. Village Level Workers, Agricultural Demonstrators etc. | 62.6 |
| 2. Block-Level Extension Officers for agriculture, animal husbandry, cooperatives etc. | 14.2 |
| 3. Block Development Officers | 4.4 |

Generally District Agricultural Officers at district level and Deputy Directors, Joint Directors/Additional Directors are also looking after extension work in the States. In some cases there is more than one such officer and in others officers incharge of extension have certain administrative responsibilities also.

While most of the district and higher level staff and extension officers are graduates in agriculture, veterinary sciences etc., the village level workers mostly have education upto matric/higher secondary and about 1 to 2 years' training in agriculture and allied fields. In many parts of the country VLWs have produced only a limited impact because due to inadequate technical competence the farmers do not, in all cases, take them seriously. Secondly, the jurisdiction of VLWs which was formerly 10 villages per VLW and is now 5 villages per VLW in selected intensive cultivation areas is considered rather large and unmanageable. In many cases, technical help in agronomy, plant protection, fertilizer use, etc. was found inadequate and the need for district level specialists was felt. Since past few years specialists are being appointed at the district level, greater use is being made of selected progressive farmers for dissemination of the knowledge of new techniques and arrangements are being made to improve the technical competence of VLWs through rigorous training and to employ better qualified extension personnel.

Manufacture of pesticides in India is making steady progress and broadly the position is as under:

(Tonnes technical grade)

| Pesticides | Licenced capacity | | Current production |
|---|---|---|---|
| | Sanctioned | Under consideration* | |
| BHC including Lindane | 10,700 | 38,100 | 10,000 |
| DDT | 4,200 | 3,000 | 2,650 |
| Organic-phosphates | 2,520 | 11,992 | 1,100 |
| Endrin | 1,000 | - | - |
| Carbaryl | - | 7,000 | - |
| Organic and Manurial salts | 111 | - | 15 |
| Organic seed dressers | 300 | 1,254 | 300 |
| Copper oxychloride | @2,284 | 1,000 | 1,500 |
| Thiocarbamate | 2,500 | 2,624 | 1,600 |
| Sulphur (dust and wettable) | 6,500 | - | 6,000 |
| Fumigants | 5,000 | 300 | 50 |
| Zinc phosphide | 350 | 150 | 300 |
| Weedicide | 100 | 4,200 | 60 |

* - letters of indent have been issued in a majority of the cases.

@ - further capacity is not considered necessary as the existing one can expand considerably.

Ample capacity for manufacturing various formulations like dusting powders, water dispersible powders, emulsion concentrates, granules and smoke generators has been created in the country. The total licenced capacity for manufacturing formulations of different types is about 120,000 tonnes of technical grade materials of all pesticides.

The manufacture of power sprayers has been undertaken in India. Previously the engines for power sprayers were being imported but now their manufacture has also been undertaken and the annual capacity indicated by the manufacturers is about 30,000 engines per year. Further expansion in the manufacture of the plant protection equipment is expected. Industries manufacturing such equipment and pesticides have been included among priority industries

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which implies relatively liberal treatment in allocation of foreign exchange for imports and certain credit facilities.

Fertilizers:

Fertilizers have become a major factor in improved agriculture and increased production. In the past 15 years Government made positive efforts through subsidies on fertilizers, fertilizer demonstrations and other extension measures to make the farmers fertilizere minded. These efforts have greatly succeeded. The figures below indicate, in terms of nutrients, the progress of consumption of fertilizers and the targets envisaged under the Fourth Plan.

(Thousand Tonnes)

| Year | Nitrogen | $P_2O_5$ | $K_2O$ |
|---|---|---|---|
| 1950-51 | 65 | 8 | 6 |
| 1960-61 | 193 | 69 | 26 |
| 1965-66 | 600 | 132 | 78 |
| 1970-71 (Target) | 2,400 | 1,000 | 700 |

A Fertilizer Enquiry Committee was appointed by the Government in 1965 to look into various aspects of the problem of consumption, production, prices and distribution etc. of fertilizers. Most of the recommendations of this Committee have been accepted by Government andy they form the basis for fertilizer policy under the Fourth Plan. The targets of consumption and indigenous production and estimates of import requirements for the Fourth Plan period have been indicated as under:

( in thousand tonnes)

| Year | Nitrogen | | | $P_2O_5$ | | | $K_2O$ |
|---|---|---|---|---|---|---|---|
| | Target | Indigenous production | Import | Target | Indigenous production | Import | Entire quantity to be imported |
| 1966-67 | 1,000 | 308 | 692 | 370 | 155 | 215 | 20 |
| 1967-68 | 1,350 | 500 | 850 | 500 | 275 | 225 | 30 |
| 1968-69 | 1,700 | 760 | 940 | 650 | 365 | 285 | 45 |
| 1969-70 | 2,000 | 1,000 | 1,000 | 800 | 410 | 390 | 55 |
| 1970-71 | 2,400 | 1,700 | 700 | 1,000 | 520 | 480 | 70 |

In the petro-chemicals sector, highest priority is being given to the production of fertilizers in the country. To meet the gap in requirements and internal production large quantities of fertilizers have to be imported for some years inspite of very tight foreign exchange situation faced by the country. The latest position with regard to the capacity created, licenced and schemes under consideration for nitrogenous fertilizers is given in tbe table below:

Installed capacity by 1970-71

| | |
|---|---|
| Capacity created so far | 5,85,000 tonnes 'N' |
| Licensed. | 22,53,000 tonnes 'N' |
| Under consideration | 2,50,000 tonnes 'N' |
| Total | 30,88,000 tonnes 'N' |

Largely India is depending on indigenous availability of naphth as the base for nitrogenous fertilizers. In respect of phosphatic fertilizers there is considerable dependence on sulphur imports. Generally there are difficulties in the world market for these impor Probably there may be number of problems common to many ofthe Colomb Plan countries which could be jointly considered.

Soil testing laboratories have been set up in each State. Soil samples from farmers fields are analysed for their nitrogenous, phosphatic and potassic nutrient content as also for their reaction (acid, alkali etc.) and their contents of soluable salts, so as to help in suggesting proper fertilizer application practices. Soil testing services are proposed to be expanded during the Fourth Plan. Mobile Soil Testing Units are being set up.

Result of crop cutting survey on high-yielding varieties of cereal crops grown in IADP districts during 1966-67

| Crop/District | High-Yielding variety | Season | Average yield (Quintals/hec) | | % increase over control |
|---|---|---|---|---|---|
| | | | High yielding variety | Control | |
| RICE | | | | | |
| West Godavari | Taichung Native-I | Kharif | 24.4 | 19.2 | 27 |
| | " | Rabi | 21.9 | 15.9 | 38 |
| Raipur | " | Kharif | 14.1 | 9.7 | 45 |
| Bhandara | " | " | 11.9 | 9.3 | 28 |
| Shahabad | " | " | 14.7 | 7.7 | 90 |
| Sambalpur | " | " | 11.6 | 6.2 | 87 |
| | " | Summer | 20.4 | 11.3 | 81 |
| Surat | " | " | 15.3 | 14.6 | 5 |
| Burdwan | " | " | 20.5 | 17.3 | 18 |
| | N.C.-678 | " | 21.0 | 13.5 | 56 |
| Palghat | Tainan-3 | Autumn | 25.1 | 15.2 | 65 |
| | " | Winter | 30.4 | 22.5 | 35 |
| Thnjavaur | ADT-27 | Kharif | 18.6 | 12.6 | 48 |
| WHEAT | | | | | |
| Ludhiana | Mexican | Rabi | 47.3 | 23.6 | 100 |
| Shahabad | " | " | 15.7 | 6.8 | 131 |
| Aligarh | " | " | 28.3 | 18.8 | 51 |
| MAIZE | | | | | |
| Aligarh | Hybrid | Kharif | 17.2 | 11.5 | 50 |
| BAJRA | | | | | |
| Aligarh | Hybrid | Kharif | 11.2 | 10.2 | 11 |

## Progress of the Intensive Agricultural District Programme

| Item | 1964-65 | 1965-66 | 1966-67 |
|---|---|---|---|
| No. of villages covered under IADP | 22,029 | 23,561 | 24,336 |
| Gross cropped area covered in lakh hectares | 25.37 | 28.91 | 31.73 |
| Gross cropped area covered as percentage of the total gross cropped area in the districts | 31.3 | 35.7 | 39.1 |

Lessons of the agricultural transformation in India

C. Subramaniam

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There is world wide interest today in the changes taking place in India in the agrarian scene. Even diehard economists refer to the storm of change now sweeping one of the oldest and deep-rooted citadels of subsistence farming as a 'miracle'. The change in the outlook of the farming community is sudden but is based on mature considerations arising from a conviction that the change provides the only hope for a prosperous life. Before considering how this change occurred, I would like to give a brief outline of the food situtation in India during the last 100 years and also provide some basic data concerning Indian agriculture.

1. Food scarcity:

Many years ago, Mahatma Gandhi said that 'if God were to appear in India, He would have to take the form of a loaf of bread'. It is ironical that India which enjoyed a great reputation in Europe since early times for some of its outstanding plant products such as spices and for its excellent textiles, has during the last century had to face many famines. During the reign of the East India Company, severe famines occurred in the years 1770, 1784, 1802, 1824 and 1837. After the administration of the country was taken over by the British Government from the East India Company, great famines occurred in North West India in 1860, in Orissa in 1865, in Rajasthan in 1868, in Bihar in 1875 and in South India in 1876. The Orissa-Bengal famine of 1865 to 1867 affected nearly 50 million people. Following the famine of 1876, a Famine Commission presided over by Sir Richard Strachey was appointed. Since then, many Famine Commission have followed. The Agricultural Department in India itself was

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established following the report of the first Famine Commission. I am mentioning all these historical details only to stress the fact that there have been periodic scarcity of foodgrains even before the present population explosion tookplace. Our agriculture had remained stagnant over a long period of time and consequently, there was not enough food whenever the weather conditions were not favourable for crop growth. Thus, our agricultural fortunes remained entirely dependent upon natural factors.

Problems of Indian Agriculture:

Land Resources: The total geographical area of India is about 326.8 million hectares of which about 137.8 million hectares or 42 percent was under cultivation in 1964-65. The gross cropped area in 1964-65 was 158 million hectares. The acreages under principal crops are given in Table 1. The cropping intensity for the country is about 115 per cent. Even on irrigated lands the cropping intensity is only about 117. A close studyand analysis of the situation reveal that the reasons for the low intensity of cropping are:

i) Provision of irrigation facilities as a means of protection against drought rather than as a means of intensive cultivation;

ii) Cultivation of long duration and photo-sensitive varieties of crops by cultivators which mature by the time when even the moisture provided by late rains can not be available forthe subsequent crop;

iii) Adoption of the age-old practices by cultivators of leaving the land fallow after one crop to enable it to recuperate the fertility and non-utilisation of fertilizers as well as compost on a large scale.

Sub-division and fragmentation of holdings had been increasing due to the prevalent laws of inheritance, growing pressure of population and inadequate development of industry and trade. Uncontrolled grazing, absence of systematic efforts to check soil erosion, spread of desert, formation of ravines and gullies in vast areas of the country have also caused deterioration in land resources and their productivity.

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III

Fighting protein hunger

It has been estimated that well over two-thirds ofthe children in India are suffering from protein malnutrition. This has serious implications for the future of the country, in view of the relationship between protein nutrition and brain development in pre-school children. Among the steps now being taken to fight protein hunger are:

a) Production and distribution of Bal Ahar which is a protein rich food for children, (b) toning of milk with a protein isolate solution, (c) production of oilseed flours and concentrates (d) fortification of bread with lysine and methionine, two of the essential amino acids in short supply in a vegetarian diet, (e) production of fish protein concentrates and (f) development and commercial production of high protein foods. In addition, attempts are being made to increase the production and consumption of pulses, fruits and vegetables. Research is underway to produce single cell protein from petroleum through growing micro-organisms on hydrocarbons.

Thanks to the generous assistance of the Rockefeller Foundation, the Indian Agricultural Research Institute at New Delhi has launched an intensive programme of breeding new varieties of wheat, maize, Sorghum and rice with more lysine content. The wheat variety 'Sharbati Sonora' developed by Drs. M.S. Swaminathan, and C. Varughese at the I.A.R.I. has 50% more lysine than the varieties now cultivated in India. Rats fed with this wheat variety gained 20% more weight than those fed with similar quantities of other wheat varieties. Promising strains are also under development in the other crops.

Another important finding made at the I.A.R.I. is that rice and wheat cultivated with the fertilizer doses recommended under the High-yielding Varieties Programme have 30 to 60% more protein than those cultivated in the usual manner. Thus, in rice the protein content has been found

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to increase from 8% to over 13% when about 80 Kgs of N are applied per hectare. Thus, the new strategy has led to an additional benefit, namely to increase the protein content of cereals and millets.

International Collaboration and the Contributions of the Rockefeller Foundation :

We in India have been fortunate in havinghad help from the United States as well as many other countries in an abundant measure both for fighting the scarcity conditions of the last two years as well as for launching the country on the road to scientific agriculture. I would like to take this opportunity to express our gratitude to the Government and people of the United States for their generous help. We areparticularly indebted to the Rockefeller Foundation whose association in our agricultural development opened a new era in agricultural research and education. The All-India Coordinated Maize Improvement Project which we started in 1957 in collaboration with the Rockefeller Foundation has not only been of great benefit to India but has become the spearhead of an Asian revolution in maize production. Under this Project, scientists working in the different parts of the country were brought together under a coordinated project and a multiinstitutional and multi-disciplinary approach was introduced into the research programme. The effectiveness of such an approach will be obvious from the fact that within four years of the initiation of the project, four double cross hybrids were released to suit the needs of the different parts of the country. Since then, five more hybrids have been released and these have given yields ofthe order of 4 to 8 tonnes per hectares in different parts of the country, in contrast to a maximum yield of about 3 tonnes from theopen pollinated varieties. More recently, composite varieties which are as high yielding as the hybrids and whose

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IV

## New Problems arising from the success of the strategy.

The 1967-68 crop year is a very significant one in India's economic history. During this year, it is anticipated that the total food production will exceed 100 million tonnes, which represents a doubling of the total production since the beginning of our First Plan in 1951. Also, there will be a total wheat production of over 17 million tonnes, in contrast to the 7 million tonnes in 1951. The present crop year is the first year since the initiation of the new strategy when the weather has been normal in most parts of the country and the results encourage the view that we are now at the beginning of a new era in our agriculture, an era which will be characterised by the problems of surplus than of scarcity. There is a great enthusiasm among farmers for the new varieties and the new agronomy and there is a growing hunger for inputs. The motivation necessary for change has been created and educated classes who had deserted farming, are now returning to it. Agriculture has acquired its rightful social status and the psychological base necessary for change has been truly laid. A climate of confidence has been generated in the country concerning India's agricultural production potential.

Frequently in the past and sometimes even now, a criticism is made that in India research and extension function without proper coordination and interaction. There is some basis in this criticism and frequently in the past, research findings of great applied value were made no different from 'ivory tower' research,

by not taking the administrative steps necessary for exploiting the scientific innovation. However, I am proud that India now holds the world record for the speed with which a significant research finding has been applied inthe field. It was in 1962 that Dr. M.S. Swaminathan of the Indian Agricultural Research Institute conceived of the need for going in for dwarf wheat varieties in order to destroy the barriers limiting the yield of this crop and submitted a proposal for getting the services of Dr. N.E. Borlaug and of dwarf wheat material from Mexico. Thanks to the generous assistance of the Rockefeller Foundation both these proposals fructified and in 1963-64 yield tests were organised in several parts of India by the Indian Agricultural Research Institute with the dwarf wheats received from Mexico. These tests were repeated in 1964-65 and data sufficient to induce the Govt. to take the decision of importing 250 tonnes of seeds of two Mexican wheats - Sonora 64 and Lerma Rojo - were presented in June, 1965. These wheats had such a great impact on the minds of farmers that at the request of the Chief Ministers of our States, we decided to import 18,000 tonnes of seeds in 1966. I understand that until 1967 when Pakistan and Turkey follwed our example and imported even larger quantities, our import of 18000 tonnes of seeds was the largest operation of its kind in the world. During 1966-67 we had nearly 400,000 hectares under dwarf varieties and during 1967-68, we have over 200,000,0 hectares under such wheats. There is probably no parallel for such speedy action and fast spread of varieties. In the implementations of our ideas and decisions, the Rockefeller Foundation

has been of immense help to us and I wish to express the gratitude of our people to the Foundation.

If the strategy of agricultural development we initiated in 1965 is taken to its logical conclusion, famine can be banished for ever from our land. Also, the rural prosperity arising from agrarian advance would help to create a sound base for industrial progress. We are now turning our attention to the new problems created by the success of the strategy, such as storage, marketting and pricing. Fortunately we had created machineries like the PricesCommission and the Food Corporation of India to tackle such problems. I am confident that India will not only belie Malthusian economists and all prophets of gloom but also establish new patterns of growth in agriculture, provided the prevailing climate of confidence does not degenerate into a climate of compacency and consequent inaction in solving the new problems we have to face hereafter.

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