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Technology missions as a way to achieve set goals

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My esteemed members of the General Body and Executive Committee of the Indian Society of Genetics and Plant Breeding and Fellow Scientists:

I consider it a privilege and honour to be the President of one of the oldest, largest and prestigious societies of the country, namely, the Indian Society of Genetics and Plant Breeding. I had the privilege of being associated with this society for a long time ever-since I joined the then Botany Division (now Division of Genetics) of the IARI in 1952 and served it in various capacities as a Member, Secretary, Vice President and President. Thanks to the great vision of the founding fathers of the Society who met at the Indian Science Congress held at the Holy City of Banaras in 1941 and took a decision to start our Society to strengthen plant breeding and genetics and enable our scientists to publish the results of their investigations in the Society's official publication, The Indian Journal of Genetics and Plant Breeding. Sir T S Venkataraman, Dr W Burns, Dr K Ramaiah, Rao Bahadur Chowdhury Ram Dhan Singh, Dr B P Pal, are some of the main persons who laid the foundation to this Society. Dr B P Pal the doyen of the Plant Breeders of India was instrumental in nurturing this Society in various capacities for a number of years and took personal interest in the growth of the Society till his death. Great many scientists, past and present, who played a critical role in the agricultural development of India were the office bearers of this Society. On this occasion let us remember all these great men, follow their footsteps and take the Society to new heights in the years to come.

The plant breeders and geneticists played and continue to play a critical role in the development of Indian agriculture. They acted as catalysts of change. The varieties or hybrids of different crops they developed played critical role in increasing production and productivity of Indian agriculture. These varieties/hybrids also enabled us to deal with different biotic and abiotic stresses, adaptability issues and required quality needs. The identification, development and popularization of dwarf genotypes of wheat and rice and the multidisciplinary approach followed in the 1960s ushered in the Green Revolution in the country. The fourfold increase of production and productivity of food grains and similar advances in several other crops and the large buffer stocks of rice and wheat gave the country a breathing time to plan its future agricultural strategy to meet the demands of the growing population and the diversified needs of the society without depending on imports as in the past. India instead of remaining as a food receiving country ever-since independence, became a food surplus country and also a modest exporter of foodgrains in the international market. It was also able to supply foodgrains to needy countries in Africa, Asia and elsewhere in the world. Seed played a critical role in all our developmental programmes initiated by Government of India from time to time. This made me to boldly say in different occasions — Your agriculture is as strong as your seed programme, if your seed programme is weak your agriculture is weak and, if your agriculture is weak, your food security is weak and if your food security is weak your national security is weak. I am sure our plant breeding, genetical and cytogenetical work will continue to carry on the critical job of producing more and more better varieties and hybrids in future with the required capacity to withstand different biotic and abiotic stresses and along with the quality required in the competing global market.

Modern agriculture requires inputs from several sources to achieve set goals of the society. Plant breeding alone, or in that sense, no other discipline alone will be able to meet all the requirements of the society. It requires multi disciplinary and multi pronged approaches and strategies. In this context, I would like to share with you the experiences we gained in operating the Technology Mission on Oilseeds in our country which, because of its success, prompted the Government of India to initiate more technology missions to achieve set goals.

Technology Mission as a technique or a method to achieve goal of a particular problem was initiated in 1986 by the Hon'ble former Prime Minister of India Shri Rajiv Gandhi. Five technology missions were initiated, out of which Technology Mission on Oilseeds

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was one. This was clear in the Convocation Address given by him at the IARI, New Delhi in February, 1986. To quote Shri Rajiv Gandhi, "One of our biggest problems today in the agricultural sector is the oilseeds. We are setting a thrust mission for oilseed production. When we talk of a mission we mean an exercise starting from engineering of the seeds and, finishing with the finished products of the vegetable oil which could be delivered to consumer. We would like to put one person In-charge of such a mission with full funding with no restriction on him whether bureaucratic or otherwise. The only limits will be certain achievements which must come within a certain time frame. This will cut across a number of Ministries where you find a lot of hassles and we find our projects getting stalled because the interaction is not smooth enough. We have already decided on this particular mission".

The responsibility of the Technology Mission on Oilseeds was given in May 1986 to the Department of Agricultural Research and Education (DARE) and the Indian Council of Agricultural Research (ICAR) and the Department of Agriculture & Cooperation in the Ministry of Agriculture. I had the good fortune to head this Mission as its first Director. The oilseed production has been stagnating for a long number of years but the consumption of oil was increasing, forcing the Government to import large quantities of oil year after year at the expense of valuable foreign exchange. A target was fixed for a Technology Mission to increase the oilseed production from 11 million tons to 26 million tons by 2000 AD and vegetable oil production from 3.6 to 8.0 million tons.

Taking stock of the prevailing oilseed scenario

The area under oilseeds was fluctuating between 18 - 20 million ha. during the period 1981-1985 and production between 9 - 12.9 million tons and productivity from 563 - 684 kg per ha. The percentage of area under oilseeds which received irrigation was varying between 14 - 17%. All the oilseed crops were mostly hungry and thirsty as the resource poor farmers particularly under dryland conditions, were not able to provide the needed inputs of fertilizers, water or plant protection. The erratic monsoons further put the oilseed production at risk. There was neither a well developed technology nor high yielding varieties like in wheat and rice to push up the oilseed production. Most of the oilseed crop varieties were susceptible to a large number of pests and diseases and they were also affected by abiotic stresses like drought, salinity, alkalinity etc. The devious market forces also dampened the enthusiasm of the farmers to go for oilseed cultivation. The efforts that have been made earlier through research and development activities have not increased production to any appreciable extent to meet the growing demands of both edible, and non-edible oils. India imported in 1983 - 84 alone 1.6 million tons of vegetable oil costing Rs. 13,190 millions. Unless some break through in the oilseeds scenario is brought forth the imports are likely to increase year after year, severely taxing our foreign exchange resources.

India is a home for many oilseed crops. The major oilseed crop of the country were groundnut, rapeseed-mustard, sesamum, safflower, niger, castor and linseed. Area under soybean and sunflower was limited and coconut oil consumption was localized. No systematic effort was made in the past to improve the oil content nor to produce seed and supply to the farmers. In this background, the Technology Mission on Oilseeds was expected to achieve the goal of self-sufficiency in a stipulated time frame. The strategies followed in case of wheat and rice were different and new strategies had to be developed in the case of oilseeds. The experience of handling the successful All India Coordinated Wheat Improvement Project for 10 years directly and, other crop projects indirectly in the ICAR, was a great asset in visualizing and developing strategies to achieve the set goals in the oilseed mission.

A SWOT (Strengths or Weaknesses and Opportunities or Threats) analysis revealed that we have the strength of soils, climate, research and developmental infrastructure to grow horizontally and vertically by encouraging oilseed crop cultivation and also by use of need based necessary inputs. Since the soil and climatic conditions of the country are very diverse, a number of oilseed crops can be grown and exploited which is not the case in most of the countries around the globe. The present yield gap is a great opportunity to exploit. The well laid out demonstrations by the scientists on farmers fields by use of available knowledge and technology has clearly indicated the possibility to bridge the gap between what is being obtained by the farmers and what is possible. Fortunately, India has well developed infrastructure of Departments of Agriculture, Forestry, scientific bodies and a strong industry who could be brought into the mission activities for a coordinated approach. At the same time, the major threat to the domestic oil industry i.e., the import of cheap vegetable oil from abroad without checks and balances which dampened the initiative of local farmers had to be gradually brought down in a phased and planned manner. The above scenario necessitated intense interactions between different Ministries and Departments including Commerce and Civil Supplies Department and Council of Scientific and Industrial Research (CSIR). The Department of Agriculture was involved with extension and in fixing remunerative prices of different oilseed crops to enthuse

farmers to cultivate oilseed crops. Similar intense discussions were organized in every oilseed growing State involving all the concerned departments, policy makers, administrators and farmers organizations. Based on all these intensive evaluation and discussion process and keeping the critical role of farmers who grow the oilseed crops for bettering their income, it was realized that four mini missions which cover all the activities of the oilseed scenario in its totality, should be started both at Central and State level to impart momentum to the Technology Mission on Oilseeds. These mini missions were:

Mini Mission I	Dealing with crop technology
Mini Mission II	Farmer support system
Mini Mission III	Price support, processing, storage and marketing
Mini Mission IV	Post harvest and processing technology.

The departments and the principal players in operating these Mini Missions were identified both at Central and State level. Seventeen different agencies were involved in the various activities dealing with vegetable oil scenario. The Technology Mission on Oilseeds realized and recognized at the very outset the critical role of technology in production and processing and coordinating in an integrated way all the activities. The participatory role of all the agencies and farmers was also fully realized and a bottom-up rather than a top-down approach was followed. Incentive prices for each of the oilseed crops were announced from time to time to enthuse the farmers. All involved individuals, Departments and Ministries identified themselves as full partners in achieving the objectives of the Mission. This cooperative, coordinated approach with a sense of ownership and commitment by all partners was one of the main reasons for the success of the Technology Mission on Oilseeds.

Strategy

The Technology Mission on Oilseeds drew up the following strategic plans after due deliberations:

1. Identification of crops/States/areas which have the highest potential for increasing production.
2. Develop short term and long term plans.
3. Identification of institutions and leaders at every level, who will implement the plans and programmes.
4. Organise field demonstrations on a massive scale with available technologies and sensitize farmers and extension workers.
5. Development of activity milestones, time frame and implementation and review methodologies.
6. Constant review of the progress by the Mission Director and the high powered Steering Committee jointly headed by the Secretary of Agriculture and Cooperation and the Secretary DARE and Mini Mission Leader's and regularly reporting to the Prime Minister's Office about the progress.
7. Organize national seminars and state level seminars, regional workshops involving scientists, industry, policy makers etc.,

The different strategies which played well were:

(a) Identifying crops, technologies and areas that could be exploited at the shortest possible time for increasing production, productivity and extractability of oil

(b) Identification of non-traditional areas of the country where the crops could be introduced and exploited

(c) Introducing on a large scale non-traditional crops

(d) Improving the oil extraction technologies in different mills

(e) Exploitation of rice bran and cotton seed as a source of oil and

(f) Exploitation of tree species of forest origin.

While implementing these strategies high importance was given to:

(a) *Rabi* groundnut production

(b) Moving rapeseed-mustard on a big way to Rajasthan and non-traditional areas like Central South and East India

(c) Extending area of cultivation and intensifying production and processing technologies of soybean

(d) Import of seed of high yielding varieties/ hybrids of sunflower and popularizing it

(e) Introduce high yielding tenera hybrid plant material of oil palm

(f) Import of rice bran technologies from USA/North Korea

(g) Improving solvent and other rice bran extraction technologies

(h) Announcing remunerative prices

(i) Extension of existing knowledge and development of new knowledge

(j) Extraction of oil from cotton seed and maize

(k) Blending, packaging and storage technologies

(l) Strong support of DOA&C by developing NODP

(m) Gradually reducing the import of oils

(n) Thrust to seed production

(o) Strengthening research

The above strategies based on scientific analysis gave significant boost to oilseed production and reduced the import bill.

Achievements

As a result of the thrust given by the Government of India, through Technology Mission on Oilseeds the goals of increasing domestic production and reducing the dependence on imported oil were achieved.

1. Between 1985 - 86 to 1998 - 99 the production of oilseeds increased from 10.83 to 24.75 million tons and yield per hectare increased from 570 to 944 kg. The area under oilseed crops increased from 19.02 to 26.23 million hectares.
2. The strategy of non-traditional areas and non-traditional crops paid rich dividends.
3. The thrust given to rabi groundnut, soybean, rapeseed-mustard, sunflower, oil palm paid well.
4. The solvent extraction technologies, the conversion of hullers to shellers and cotton seed and rice bran extraction technologies gave good results.
5. By 1992-93 and 1993 the import bill on vegetable oils had come down very significantly.

The crucial lesson that was learnt from the Oilseed Mission when it was started and operated in the initial stages was the realization of the crucial role of technology and technology driven scientific approach, coupled with the teamwork of different players in the vegetable oil scenario. The experiences of giving science based mission approach could be similarly implemented in achieving goals in other missions. As a plant breeder, pathologist and coordinator I had the privilege of being associated with this successful technology mission on oilseeds and I thought I should share my experiences with all of you so that some of you will lead other missions in the country to make India rich, strong and vibrant. It is pertinent to quote His Excellency the President of India Dr A P J Abdul Kalam who said "The economic strength has to be powered by competitiveness, competitiveness has to be powered by knowledge and knowledge has to be powered by mission". The technology and the identification of strategies and their implementation, monitoring, coordination, constant review and keeping the policy makers regularly informed was the driving force behind the Mission. The experience of technology driven wheat and rice production is a constant reminder that the role of technology cannot be underestimated in implementing Technology Missions. With the diverse soil and climatic conditions, technical manpower, infrastructure we have in India, if this technology based approach is followed in other technology missions like pulses, cotton, corn, horticulture, coconut etc. with knowledge, commitment and continuity and involving all the concerned people, the set goals can not only be achieved but surpassed.

Having talked about the Technology Missions as a way to achieve set goals I would like to share with you some of my concerns about the future agricultural scenario of the country.

It is necessary to take stock of the yet to be accomplished jobs and the challenges in agriculture and the role the plant breeders and geneticists can play. Some of these are:

1. India needs more food and better food. It is not only to meet the requirements of growing populations but also meet the special requirements of nearly 300 million people estimated to be below the poverty line. According to the NNMB survey many Indians are suffering not only due to malnutrition and under nutrition but also due to deficiency of different micronutrients which are getting depleted in our soils due to exhausting cropping patterns, management practices and unbalanced fertilizer usages. It is estimated that India needs 420 million tons of foodgrains by the year 2015. In the limited land we have we are expected to produce 160 MT of rice, 100 MT of wheat, 160 MT of pulses, coarse cereals and oilseeds and 300 MT of vegetables. The report points out the fact that hunger and disease continue to torment large segments of population particularly in the rural and tribal areas and urban slums of India. The National Social Watch Coalition after survey of 13 States in the country reported Poverty forces 48% of the people in the villages to skip meals. In this challenging scenario the question is whether the breeder and geneticist could again act as a catalyst of change?
2. In spite of the fact that India has the highest irrigated area in the world, still more than 60% of its agriculture depends on natural resources and the monsoons. Many of the essential commodities like pulses, coarse cereals, oilseeds, several commercial crops including cotton and even 40% of paddy are dependent on rain water. The food and agricultural economy are still influenced by vagaries of rainfall. In rainfed areas unlike in irrigated areas there is no breakthrough of technologies for wide acceptance and exploitation to increase production and productivity. Unless a revolution in rainfed agriculture is brought, food security of India cannot be assured on an enduring basis. Can plant breeders and other scientists bring a revolution in rainfed agriculture?

3. Despite the fourfold increase in productivity and production of many of our crops yet the present productivity per unit area of most of our crops is below even the world averages, let alone the yields of developed countries and developing countries like China. This may be due to climate and agronomic management but genetic upgradation is also a factor that needs special thrust from plant breeders and geneticists.

4. A number of biotic and abiotic stresses still continue to ravage our crops although the breeders were able to produce some disease and pest resistant varieties/hybrids in several crops. Still several pests and diseases and their ever evolving new variants continue to pose a threat. To the already existing vast stretches of saline and sodic soils, new areas are being added by improper management of water, soil and inputs. Reclamation of such affected soils is costly and the alternative solution of resistant or tolerant genotypes have to be developed and popularized by the breeders and the geneticists.

5. Competition is the order of the day in the present WTO, globalization and liberalization scenario. The developing food industries in the country demand a specific quality of raw materials. If India has to meet these requirements appropriate varieties/ hybrids have to be developed by the breeders and geneticists and cultivated on a cost effective basis to ward off imports. Scientists have also to identify favourable areas which can be exploited on eco and farmer friendly basis.

6. Biotechnology and its exploitation in crop improvement is moving by leaps and bounds particularly in countries like USA, Canada, China, Argentina etc., In certain pests and diseases and abiotic stress situations where conventional plant breeding is not able to find a durable solution, biotechnology is being looked as the only alternative. The way *Bt* cotton is spreading, whether legally or illegally at present, shows the wide acceptance of the technology by the Indian farmer. We must realize that farmer will accept any technology if it gives him more income, involves less risks and input costs. He is not concerned with slogans and ideologies. So far, we are dependent on gene/s developed by outside sources and the farmers are paying very heavy prices for the seed. How long should we depend on genes developed elsewhere and make our resource poor farmer pay heavy price for the seeds and royalties? Is there a human face for the present discriminatory exploitation of our farmer? How and when our biotechnologists reverse this exploitation?

7. The net area sown in the country has remained static since 1970 - 71 at about 141 m ha although the gross cropped area and the area sown more than ones has increased, thanks to the additional irrigation resources added. The cropping intensity increased from 111 in 1950 - 51 to 133 in 2001. In this evolving scenario the message is clear that the breeders not only strive to increase yield/ha, resistance to different abiotic and biotic stresses and quality, but they should also keep in mind that the varieties/hybrids they produce have to fit into the multiple, sequential and, intercropping systems. The production per unit area per unit time is going to be important and the cropping and farming systems would occupy the central stage in view of the dwindling per capita availability of land. The new plant types have to be more efficient in utilizing water, sunshine and inputs. The rice-wheat rotation for example which started as a trickle few decades back in the Indo-Gangetic alluvial soils of Northern India has now become an unshakable system in spite of some negative features, not only in India but in several countries of South and South East Asia. There is a scope and also a need to include a third crop in this system which can not only improve the economic condition of the farmer but also enrich the soil. Here is another challenge for the plant breeders.

8. Gone are the days when the free exchange of genetic materials, information, knowledge and experience used to take place and the whole world was getting benefited. Now with the present international scenario of plant breeders rights, farmers rights, patenting, WTO and UPOV rules and regulations, intellectual property rights, growing role of private sector in plant breeding, royalties etc., it is becoming extremely difficult for free exchange of materials and ideas. The gene rich developing countries have got into the trap of subjugation due to technological backwardness over the technologically advanced developed countries who are having a strong commercial oriented private sector and also having the control of regulations, dealing with genes and genetic materials. This calls on our plant breeders and geneticists to fully exploit the invaluable germplasm that was and, is being assiduously collected and preserved in our national and regional gene banks.

9. A question which everyone of us has to ask ourselves is how to sustain and improve over our Green Revolution? Questions and doubts are expressed that the present Green Revolution has reached a plateau and the high input oriented technologies are rendering our soils less productive

and demanding for more and more inputs to get even the present yields. Cost benefit ratios and fertilizer responsiveness are declining. We have to run faster and faster to stand where we are. Even if we want to buy agricultural produce in the international markets, its availability and cost will be very daunting as there will be more and more countries competing for it in future, as already being predicted by world watch groups. This calls for heart searching amongst us and requires renewal-dedicated efforts, plans and strategies.

10. In the IPR regime, public sector plant breeders should be able to compete or perish. Government cannot support plant breeders in public sector if our breeders are not able to compete and deliver the goods. It is a wake up call. Clock is clicking! They have to add earnings through royalties to the system, otherwise, the system cannot maintain them. If you do not revitalize plant breeding we witness steady decay of plant breeding in India, decline in agricultural production and dependence on foreign and commercial technologies and imports.

11. The private sector plant breeding in the last few years is increasing which is a welcome complementary effort. The private plant breeding area requires more manpower and we have to meet their requirements.

12. We have to breed a new breed of plant breeder who is not only knowledgeable in the niceties of his subject matter disciplines but also knowledgeable of modern biotechnology, marker aided selection, genetic engineering etc., but also is fully conversant with PBRs, patenting, FRs, regulations in exchange of germplasm, biodiversity, rules and regulations etc. Over this requirement he has to be also a grassroot practical plant breeder with required stamina to work hard and also have the breeders eye horse sense, knowledge of farmers needs, market needs etc. He has to be a superior breed by himself! For enduring future food and environment security our goal should be an environmentally friendly biotechnology coupled with knowledgeable, ever vigilant, vibrant conventional plant breeding.

There is an urgent need on the part of the Government and policy makers to develop the needed infrastructure of modern science so that knowledgeable modern plant breeders, geneticists and cytogeneticists are produced, developed and nurtured. In this context we should also review our selection procedure to attract needed talent from conventional universities and other educational institutions without insisting on basic agricultural degree. Shri Pandit Jawaharlal Nehru our first Prime Minister said, anything can wait but not agriculture. In the same context I would like to conclude my Presidential Address by saying that anything can wait but not plant breeding. Let us not kill the goose that laid golden eggs in the past but, nurture the science of plant breeding. An economically robust agriculture is the key to overall economic development and agriculture will continue to be the backbone of Indian prosperity. Let us be full partners in developing a robust agriculture in India for many many years to come.

Thank you.