

Enhancing our agricultural competitiveness*†

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At a reception accorded to him in 1983 by the Municipal Corporation of Greater Bombay, J. R. D. Tata recalled,

‘The Bombay of my youth with its magnificent harbour, its shady wooded hills, its flowering trees, its then disciplined population – there were no morchas then to impede one’s travels through the city – its virtual absence of beggars, its freedom from law and order problems, and how happy a place it was in which to live and to work, a city of which we could be proud.’

From Lala, R. M.

Beyond the Last Blue Mountain: A Life of J. R. D. Tata

In spite of technological progress and democratic values, we have in India today nearly as many persons living in poverty and deprivation, as the entire population of India at the time of independence. J. R. D. Tata knew that the proliferation of urban slums can be stopped only by creating new avenues for sustainable livelihoods in rural India. He also knew that concurrently we should take steps to limit the growth of human numbers in the country. He used to point out that the population-supporting capacity of our major ecosystems has already been exceeded. In addition to nurturing the various Tata industries to achieve greater heights of professional and technological excellence coupled with social concerns, J. R. D. Tata helped to develop numerous outstanding scientific and educational institutions. In building the philanthropic traditions of the House of Tatas, JRD believed that, ‘sharing wealth is as difficult as creating it. Both are forms of investment and both must seek some form of return’. In his view, science and education are fundamental to human progress. Along with John D. Rockefeller, he believed, ‘if the people can be educated to help themselves, we strike at the root of many of the evils of the world’. He deprecated control by the ‘dead hand’ of bureaucracy and the stifling of the spirit of innovation and invention among common people. Above all, he wanted us not to be satisfied with a second position in any field.

I shall take agriculture and the goal of a hunger-free India as examples of the uncommon opportunities available now to fulfil the above vision of J. R. D. Tata.

*Dedicated to Prof. S. Ramaseshan on his 80th birthday.

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Agriculture cannot wait

The great Bengal famine of 1943 provided the backdrop to India’s independence. Mahatma Gandhi said at Naokhali in 1946, ‘to the hungry, God is bread; the God of bread should prevail in every home and hut of the country’. Jawaharlal Nehru aptly remarked soon after our independence in 1947, ‘everything else can wait, but not agriculture’. This pronouncement got reflected in several public policy and investment decisions, particularly in the areas of irrigation, fertilizer production, land reforms and community development.

Some major initiatives that were started from the beginning of planned development in 1950–51 are the following:

First, steps were taken to improve our capability in science and technology as applied to agriculture. Several new research institutes, for example, those dealing with rice and potato were set-up. The first Agricultural University was established at Pant Nagar in 1958. Several All India Coordinated Research Projects were initiated by the Indian Council of Agricultural Research. Second, steps were taken to produce and supply inputs like seeds and fertilizers and to expand the area under irrigation. Large multipurpose projects like the Bhakra Nangal project were initiated. Credit and extension services were improved. Finally, several public-policy measures like land reform, including the imposition of ceilings on land holdings and the redistribution of ceiling-surplus land, and the promotion of cooperatives and Panchayati Raj institutions were initiated. Finally, an Intensive Agricultural District Programme (IADP) was initiated in the early sixties in order to maximize production and productivity in irrigated areas by providing a package of inputs like seeds, fertilizer and pesticide.

Thanks to advances in preventive and curative medicine, the population also started growing at a fast rate since 1950. Advances in food production did not keep pace with the growth in food requirements caused by both increased population and higher purchasing power. The result was increasing dependence on food imports, particularly under the PL 480 programme of the United States. Several leading foreign experts concluded in the early 1960s that India was a hopeless case from the point of view of achieving a proper balance between the rates of growth in population and food production. It was under such an atmosphere of gloom and doom that Indira Gandhi released a special stamp titled ‘the Wheat Revolution’ in July 1968.

How did this transformation take place? The IADP or the Package Programme, as it was popularly known, had one important missing ingredient in the package, namely genetic strains which can respond positively to the rest of the package like irrigation water and fertilizer. It was this missing ingredient that was provided under the High-Yielding Varieties Programme of 1966 comprising semi-dwarf varieties of wheat and rice and hybrids of maize, *jowar* and *bajra*. In 1968, Indira Gandhi wanted a buffer stock of 10 million tonnes (mt) built-up speedily since she saw clearly the link between food security and national sovereignty. This buffer stock was built by the early 1970s.

Because of our policy of ensuring minimum support price to basic food crops through the Food Corporation of India, as well as State Food Corporations, the production of wheat and rice increased steadily and in 2001–2002, the Government of India had food stocks exceeding 60 mt. This enabled the Government to initiate several Food for Work programmes to insulate the poor from hunger. In spite of our agricultural progress and food safety net programmes, we now have nearly as many children, women and men suffering from poverty-induced undernutrition as the entire population of India in 1947. This tragedy is self-inflicted, since there are no political, scientific, economic or managerial excuses for the persistence of chronic under- and malnutrition today.

In my view, the political will, backed up by appropriate political and administrative action to eradicate chronic and hidden hunger caused by protein-energy and micronutrient under-nutrition is yet to emerge. If the following five steps are taken, we can still achieve a hunger-free India by 15 August 2007, which marks the 60th anniversary of our independence.

First, we should bring about convergence and synergy among all on-going food safety net programmes, on the basis of a life-cycle approach to nutrition. Such a programme for 'nutrition security at all stages in one's life' should begin with pregnant women and infants and extend up to old and infirm persons. The programmes are all there already, but what is missing is the political will to breakdown the administrative walls preventing convergence and synergy in their delivery. If grassroots democratic institutions are mobilized for implementing the whole life-cycle nutrition security programme, the transaction cost will be low.

Second, we should foster the establishment of Community Food and Feed Banks in all the hunger hot spots of the country, which will help to both diversify the food basket by including local grains like millets and pulses, and ensure delivery to the hungry at the right time and place.

Third, an integrated approach to rural on-farm and non-farm employment should be promoted, as China has so effectively done. The micro-credit-supported self-help group revolution, if carefully developed on the basis of

market-driven enterprises, can help provide the income needed for food security at the household level to the assetless population, i.e. those who have no land, live-stock or productive skill.

Fourth, the causes of hunger are diverse and the cures are also diverse. Hence, rigidly-structured national programmes alone will not lead us to the desired goal. There is need for location and culture-specific responses. For this purpose, it will be prudent to set up a *National Food Security Trust*, with an initial allocation of 10 mt of food grains. The Trust could make small allocations of 50 to 200 t of grains to Gram Sabhas/Nagarपालikas as well as credible NGOs in the hunger and hydrologic hot spots of the country to undertake 'food for social capital development' programmes designed to ensure food for everyone without destroying human dignity.

Finally, there is no time to relax on the production front. There is an urgent need to strengthen the ongoing process of farming systems' intensification, diversification and value addition. In a predominantly agricultural country like ours, an evergreen farm revolution based on higher productivity in perpetuity is the best safety net against hunger and poverty. Productivity improvement leading to a higher marketable surplus is particularly important for small farmers, since there is more poverty in countries where the population engaged in agriculture is over 60%.

Our agriculture is usually referred to as a 'gamble in the monsoon'. Increasingly, it is becoming a gamble in the market. In domestic trade, both cost and quality influence consumer demand. In international trade, in addition to competitive cost and desirable quality, stability of supply becomes extremely important. If appropriate technologies and remunerative marketing opportunities get integrated, impressive production gains can be achieved, as our experience during the last 20 years shows. Under commercial agriculture, the old distinction between 'food and cash crops' vanishes and all crops become 'cash crops'. This is where government policies in the area of infrastructure development for improved post-harvest technology, marketing and transport as well as steps for ensuring fair returns to producers and reasonable prices to consumers become very important. Most developing nations have to simultaneously improve production by small farmers and consumption by the rural and urban poor, and hence attention to policy formulation becomes crucial to success, particularly in the context of globalization of trade and removal of quantitative restrictions on the import of agricultural commodities and products.

In the area of consumption also we face two contrasting challenges. On the one hand, the rural and urban poor suffer from undernutrition and malnutrition due to inadequate purchasing power. On the other hand, food habits of the more affluent sections of the population are fast changing with greater emphasis on fruits, vegetables and

animal products. We also witness the paradox of abundant grain reserves co-existing with millions of people suffering from undernutrition in our country. As early as 1861, Col. Baird Smith remarked that 'Indian famines are not famines of food but of work. Where there is work, there is money and where there is money there is food'. *If a famine of food was the major obsession in the immediate past, a famine of jobs or livelihood opportunities is currently the major cause of endemic hunger.* Imaginative Food for Work and Food for Social Capital programmes will help to mitigate the situation.

It is obvious that the farm sector alone cannot absorb all the surplus landless labour in the rural areas. We have to give a new orientation to the concept of land reform and widen this concept to include all forms of asset reform. For example, one of the greatest assets in rural areas could be the intelligent and effective use of emerging technologies such as biotechnology, and information and communication technologies. Unless steps are taken immediately to train rural women and men, particularly belonging to landless labour families in relevant technologies, the poor will again be bypassed by the new technological opportunities. *In fact, rural development should be defined as the conversion of all unskilled persons into skilled ones.* It is only in this way that productivity can be enhanced and quality of life improved. Instead of just measuring 'yield gap', we should turn our attention now to the study and removal of the constraints responsible for 'knowledge gap' in rural professions. Just as the green revolution of the sixties enhanced our self-confidence about our agricultural capability, a knowledge revolution is now necessary to enhance our agricultural competitiveness.

Building a sustainable water security system

Irrigation water security is essential to ensure our agricultural competitiveness. The *water emergency* we face in parts of the country from time to time, both due to drought and the unsustainable and inefficient use of most water resources, particularly of groundwater, has brought home the urgent need for launching a *Jal Swaraj* movement based on the conservation of every drop of water and its sustainable and equitable use for domestic, agricultural and industrial purposes. In 1980, when I was in charge of Agriculture, Rural Development, Irrigation and Science and Technology in the Union Planning Commission, a five-point strategy was included in the VI Plan (1980–85) for developing a sustainable water security system for the country.

- (i) Rainwater harvesting and storage in a manner that evapo-transpiration losses are minimized.
- (ii) Participatory watershed development and management, and desilting and renovation of ponds, tanks, lakes and reservoirs.

- (iii) River-water sharing and efficient and equitable use.
- (iv) Waste water (including sewage water and industrial effluents) treatment and recycling, and
- (v) Sea water use along the coast for raising mangrove and salicornia plantations together with aquaculture.

All the above water sources need to be used in a conjunctive manner. Also, in the case of dry farming areas, community conservation of rainwater will happen only if there is equity in water sharing. For this purpose, all farm families should agree to grow only low-water-requiring but high-value crops like pulses and oilseeds. Such a method of water conservation-cum-improved livelihood security can be achieved through the organization of Pulses and Oilseeds Villages.

In addition to the above immediate measures, steps were proposed in the VI Plan for developing a long-term plan for linking the major rivers of peninsular India, like Krishna, Godavari, Mahanadi and Cauvery, as well as for the desalination of sea water. Peninsular rivers are under our political control, unlike the Ganges, Indus and Brahmaputra which have international dimensions.

The revised National Water Policy (April 2002) of the Government of India contains the following statement.

'Non-conventional methods for utilization of water such as through inter-basin transfers, artificial recharge of groundwater and desalination of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, need to be practised to further increase the utilizable water resources. Water should be made available to water-short areas by transfer from other areas, including transfers from one river basin to another, based on a national perspective, after taking into account the requirements of the areas/basins.'

It is high time we move in the direction of rainwater harvesting, watershed development and conjunctive use of rain-, river-, ground-, treated-, sewage- and sea-water. China, which has taken a long-term view in the area of building a national water security system, has already made much progress in building the gigantic Three Gorges Dam, for taking the waters of the Yangtzi River to the parched lands of the northern parts of that country. The Three Gorges Dam will confer multiple benefits in the areas of flood control, irrigation, drinking water supply and power generation, although it will not be free of environmental cost.

Our country, unfortunately, is one where there is often paralysis by analysis. For example, a National Water Policy was adopted in September 1987. It remained largely on paper. This Policy was reviewed and updated in April 2002. However, implementation structures for converting the policy into reality do not exist. There has been no effort to mobilize the Panchayati Raj institutions for har-

vesting and sharing water at the local level. The Centre for Science and Environment and the Akash Ganga Trust have established in Chennai a *Rain Centre*, which is a single-stop information centre on all aspects of rainwater harvesting, storage and use. We need such rain centres in every village and town in the country. In each Panchayat and Nagarpalika, at least two women and two elected members should be trained as *Water Security Managers*, capable of looking at water-security issues in their totality, namely the consumption of water to meet the needs of human settlements, agriculture, industry and ecosystem maintenance.

While there is discussion and debate relating to the quantitative aspects of water needs, the same interest is not evident with reference to the qualitative aspects of water, with particular reference to domestic consumption. It is becoming increasingly clear that the qualitative aspects of water should receive urgent attention. In particular, we need urgently a *Policy for Pesticides*, since the dangers to human health from pesticide residues in food and drinking water are increasing.

A National *Water Literacy Movement* comprising the following action points will help ensure sustainable water security.

- Collect every drop of water and use it for raising more crop per drop.
- Treat all wasted water and use it conjunctively with ground and surface water resources.
- Ensure that drinking water is not polluted.
- Create consciousness of the need to regard holy rivers, reservoirs, lakes and tanks as gifts of God on earth by not polluting them.
- Manage ground- and surface-water resources in a sustainable and equitable manner through regulation, education and social mobilization.
- Promote in coastal areas, a sea-water farming movement.

All the above steps are politically *doable* and economically *affordable*. The short-term steps mostly need non-monetary inputs, since they depend upon people's awareness and participation on account of enlightened self-interest.

In the medium term, we should initiate action to use conjunctively seawater and groundwater along the nearly 8000 km shoreline of India for raising plantations of mangroves, *salicornia*, *atriplex*, *casuarina*, cashewnut and coconut. Also, agro-aqua farms can be established all along the coast for promoting integrated systems of aquaculture and agro-forestry. Globally, 97% of water is sea water. Water, unlike oil or coal, is infinitely renewable. We should launch sea-water farming for the coastal area prosperity programme, which involves the use of sea water for raising forests along with low external input sustainable aquaculture.

Bridging technological divides in farming

Indian agriculture is at the crossroads. On the one hand, the hard-working small farm families of India have demonstrated that they will produce more and keep the country self-sufficient in its food requirements, if they are helped to do so through mutually reinforcing packages of technology, services and public policies, particularly in the areas of input and output pricing and producer-oriented marketing. On the other hand, Indian agriculture, in addition to its traditional vulnerability to the vagaries of the monsoon, is also becoming very sensitive to the vagaries of the market. Suicides by farmers are growing and the year 2002 has been a particularly cruel year for farmwomen and men due to the integrated onslaught of an aberrant monsoon and an unfriendly market, partly arising from external trade conditions. *Building sustainable Climate Management and Trade Security Systems has become an extremely urgent task*, if the agricultural progress so far achieved is to be sustained and expanded to dry farming areas. Agriculture, including crop and animal husbandry, fisheries, forestry and agro-processing and agri-business, is the backbone of the livelihood and ecological security systems of the country, in addition to being the foundation for a national food security system. Also, past experience shows that agricultural progress is the best safety net against hunger and poverty, since it provides enduring social protection to the majority of people of the country.

The four pillars of sustained agricultural progress and agrarian prosperity are: technology, training, techno-infrastructure and trade. Globally, two cultures of agriculture are emerging—one prevailing in industrialized countries, where the size of land holdings is large and where farmers are supported by heavy inputs of technology, machinery, capital and subsidy. For example, the 10 million large farmers of USA and OECD countries receive over a billion US dollars of subsidy each day. In contrast, the 110 million farming families of India in general struggle to produce under conditions of small-holdings and poor access to technology, farm equipment, capital and remunerative markets. There is a growing mismatch between production and post-harvest technologies, resulting in much spoilage and little value-addition to primary products. This is particularly true in horticultural commodities. Our reaching the number one position in the world in milk production, has however shown that given a systems approach to production, processing and producer-oriented marketing, small-scale farming will be a strength and not a handicap. We need a rapid expansion of the Kisan Credit Card initiative by NABARD and also the rapid evolution of an *Indian Common Market*.

An evergreen revolution can be achieved only if we pay attention to pathways which can help achieve revolutionary progress in enhancing productivity, quality and value-addition (both through farming systems' diversifi-

cation and agro-processing). Such revolutions are essential both for meeting the needs of the emerging Indian Common Market catering to over one billion persons, and for becoming competitive in the global market. Above all, the smaller the farm, the greater is the need for marketable surplus in order to generate cash income for the family. *The productivity, quality and value-addition revolutions have to be achieved under conditions of diminishing per capita arable land and irrigation water availability, expanding biotic and abiotic stresses, and fast-changing consumer and market preferences.* This will call for mobilizing the best in both traditional wisdom and technologies and frontier science. Among frontier technologies relevant to the next stage in our agricultural evolution, the foremost is biotechnology.

India is a mega biodiversity country. Biodiversity serves as the feedstock for the biotechnology industry and hence India has a natural advantage in becoming a world leader in food and agricultural biotechnology. The term, 'biotechnology' encompasses a wide range of technologies – both traditional and frontier. For example, the production and use of biofertilizers, biopesticides, vermiculture and bioremediation agents are essential for fostering ecologically-sustainable farming methods. Bio-processing and bioprospecting offer new opportunities for skilled jobs and livelihoods. These areas of biotechnology also offer scope for decentralized village-level enterprises operated by self-help groups. The area of biotechnology which however has evoked public, professional and political concern and apprehension is recombinant DNA technology or genetic engineering, which affords opportunities for generating novel genetic combinations through parasexual methods of transfer of genetic material. This area of research gained momentum with the discovery of the double-helix structure of the molecule of deoxyribonucleic acid (DNA), which is the chemical substance of heredity, by James Watson and Francis Crick in 1953.

The apprehensions relating to molecular genetics and genetic engineering fall under the following broad categories.

- Issues relating to *science* itself, such as its ethical implications and the problems associated with the antibiotic markers used, etc.
- Issues relating to the *control of science* such as the probability of the control of global food security falling into the hands of a few transnational corporations.
- Issues relating to *access*, such as the implications of IPR for the poor, technologies becoming more exclusive than inclusive, leading to a further expansion of the rich-poor divide in terms of technological empowerment.
- Issues relating to *the environment*, such as impact on biodiversity, possibility of 'genetic pollution' in the

centres of origin and diversity of crop plants and emergence of super weeds.

- Finally, issues relating to human and animal health, and food safety and allergenicity, which are extremely important in the case of food, feed and fodder plants.

Of the above, the ethical issues assume greater importance in medical biotechnology in areas such as human cloning. A disaggregated approach to the study of the above issues will be important for a rigorous analysis of risks and benefits. If a disaggregated approach is not used to analyse the issues involved, the conclusions arrived at in international meetings will tend to deal with them in a composite manner, as will be clear from the following statement made by an NGO and civil society organization at the World Food Summit +5 meeting held in Rome in 2002.

'Genetically modified organisms represent a threat to family farmers, other food producers, the integrity of genetic resources and human and environmental health. They will affect particularly the rural poor, who cannot afford this costly alternative.'

The benefits of molecular breeding techniques like the use of molecular markers and undertaking precision breeding for specific characters through recombinant DNA technology are immense. Work already done in India has revealed the immense potential for breeding new GM varieties possessing tolerance to salinity, drought, some major pests and diseases, and improved nutritive quality. A new era of *Integrated Mendelian and Molecular Breeding* has begun.

This is the only way we can face the challenges of the future, particularly in the context of the growing water scarcity as well as the urgent need to step up productivity in semi-arid and dry farming areas. Denying ourselves the power of the new genetics will be doing great disservice to both resource-poor farming families and to the building of a sustainable national food and nutrition security system. *Food self-sufficiency is essential for preserving our national sovereignty in foreign policy.* There is no time to relax on the food-production front.

Scientific progress in the areas of functional genomics, proteomics and the use of genetic modification techniques in medicine and agriculture, is spectacular. During the last 50 years, a majority of Nobel Prizes in Physiology and Medicine have gone to molecular biologists. The 21st Century will belong to those who help advance the frontiers of science and technology in the areas of functional genomics, proteomics, bioinformatics and molecular breeding (i.e. genetic modification). Scientific leap-frogging in both the theoretical and applied aspects of the new genetics will take place mostly in industrialized countries. China is fast becoming a world leader in the development and application of techniques relating to functional genomics and recombinant DNA technology for improving human food and health security. India will

experience serious *genetic divide*, if we do not have a well-defined and forward-looking national policy in the field of food and agricultural biotechnology. A similar policy is also needed in the area of medical biotechnology which involves ethical issues with reference to both human and animal experiments.

The country has well-defined policies in the fields of atomic energy, space applications and information technology. No further time should be lost in developing a *National Food and Agricultural Biotechnology Policy* through political consensus. A policy alone will not help unless there are implementation structures. We need an autonomous, professionally manned and managed *Biotechnology Regulatory Commission* which inspires public confidence. Improving human health and nutrition, and safeguarding and enhancing the environment should be the principal goals of such a policy.

Towards a knowledge revolution in rural India

In addition to biotechnology, there is need for greater stress on harnessing the power of information and communication technologies for enhancing our agricultural competitiveness. M.S. Swaminathan Research Foundation's (MSSRF's) experience in bridging the digital divide in rural India has provided some basic guidelines such as the following, for harnessing this powerful tool to bridge social, gender, genetic and technological divides.

- Connectivity and content should receive concurrent attention.
- Constraints must be removed on the basis of a malady-remedy analysis; for example, wired and wireless technologies could be used where telephone connections are not adequate or satisfactory. Similarly, solar power can be harnessed where the regular supply of power is irregular. The approach should be based on the principle that there is an implementable solution for every problem.
- The information provided should be demand-driven and should be relevant to the day-to-day life and work of rural women and men. Also, semi-literate women should be accorded priority in training to operate the centre, since this is an effective method of enhancing the self-esteem and social prestige of women living in poverty.
- The Knowledge Centres should operate on the principle of social inclusion, thereby presenting a win-win situation for all.
- The programmes designed to empower rural families with new knowledge and skills should be designed on the *antyyodaya* model, where the empowerment starts with the poorest and most underprivileged women and men.
- The local population should have a sense of ownership of the Knowledge Centre. It should be client-

managed and controlled, so that the information provided is demand- and user-driven.

- The local population should be willing to make contributions towards the expenses of the Knowledge Centre, so that the long-term economic sustainability of the programme is ensured. Contributions in cash or kind generate a sense of ownership and pride.
- To be effective, the following linkages will have to be developed.

(a) Lab-to-lab: This will involve organizing a consortium of scientific institutions and data providers.

(b) Lab-to-land: This will involve symbiotic linkages between the providers of information and the users, so that the information disseminated is relevant to the life and work of rural families.

(c) Land-to-lab: There is considerable traditional knowledge and wisdom among rural and tribal families concerning the sustainable management of natural resources, particularly water and biodiversity. Therefore, the technical experts should not only learn from traditional knowledge and experience, but also take steps to conserve for posterity, dying wisdom and dying crops.

(d) Land-to-land: There is much scope for lateral learning among rural families; such learning has high credibility because the knowledge coming from a fellow farm-woman or man would have been subjected to an impact analysis from the point of view of its economic and social relevance to the population.

Rural Knowledge Centres based on an integrated application of new communication technologies, like the internet and cable TV as well as conventional ones like the community radio and the local language press, can become effective instruments for harnessing the power of partnership among professionals, political leaders and public policy makers, the general public and the rural families. Such partnerships alone can help to bridge the growing gap between scientific know-how and field level do-how.

Based on the above 'learning' by MSSRF scientists, the application of ICT techniques to meet the food and water security as well as livelihood needs of the rural families is being intensified and extended through a Virtual Academy for Food Security and Rural Prosperity (VARP) with support from the Tata Social Welfare Trust and a wide range of data-generators. Agriculture, comprising crop and animal husbandry, fisheries, forestry, agro-processing and agri-business is the backbone of the livelihood security system of rural areas, where more than 70% of India's population lives. A considerable proportion of this population has no assets like land, livestock, fish-pond or any commercially viable skill. The poor are also often illiterate, a majority of them being women. Therefore, the Virtual Academy will place particular emphasis on fostering sustainable livelihood opt-

ions both in the farm and non-farm sectors. The emphasis will be on climate management and on promoting job-led economic growth in villages. In addition, the five foundations of sustainable development identified at the World Summit on Sustainable Development held at Johannesburg in 2002, viz. water, energy, health, agriculture, biodiversity and ecosystem management (WEHAB) will receive particular attention. Rural and tribal women and men who constitute the Knowledge Management Corps are the initial Fellows of VARP. The Fellows of VARP may be literate or semi-literate, but they are characterized by a spirit of innovation and capacity to adopt, adapt and improve the best available information and communication technologies.

Water quantity and quality will be the most serious constraints to agricultural advance in the coming years. Hence, all aspects of water conservation and sustainable and equitable use will be dealt with in the programmes of the Virtual Academy in great detail. Community water banks and rural 'Low Water Demonstration Parks' will be promoted. *The Low Water Parks* will be based on attention to the following three major components.

- Mulching to promote the retention of soil moisture.
- Rainwater harvesting and the conjunctive and efficient use of rain-, surface- and groundwater as well as treated effluents, and in coastal areas, sea water.
- Cultivation of high value, but low water-requiring crops like pulses and oilseeds.
- In addition to water, weather information will receive high priority. We have considerable capacity in short-, medium- and long-range weather forecasting. Such information will have to be converted into a functional meteorological package. Functional meteorology, like functional genomics, places emphasis on the action to be taken on the basis of meteorological forecasts.

India is a land of smallholdings. A small farm is ideal for sustainable intensification through eco-agriculture. A small farmer however suffers from many handicaps including access to technology, credit and remunerative markets. It is only by helping small farmers to overcome their handicaps, that small farms can become instruments of an evergreen revolution, characterized by enhancement of productivity in perpetuity, without associated ecological harm. The smaller the farm, the greater is the need for marketable surplus to derive some cash income. Our farm families can face the challenges of the new global trade regime only by achieving revolutionary progress in the areas of productivity, quality, diversity and value-addition. They have amply demonstrated through the green revolution that they are ready to help the country, if they are empowered to do so. The single most important step we need to take in bringing about such empowerment is the initiation of a Knowledge Revolution in

rural India through the effective and meaningful use of modern information and communication technologies. A *Farmer Participatory Knowledge System* should replace the present extension approach based on a mindset of patronage and not partnership.

Food for all and forever

The quantitative and qualitative dimensions of the challenge of achieving a hunger-free India are daunting. The incidence of poverty, endemic hunger, communicable diseases, infant and maternal mortality rates, low-birth-weight (LBW) children and stunting and illiteracy is high. There are however many examples where progress in the elimination of poverty-induced hunger has been rapid because of a symphony approach in dealing with the multi-dimensional problem of hunger and malnutrition. Successful experiences in the elimination of hunger and poverty have shown that synergy between political will and action; and strategic partnerships can help local communities achieve seemingly impossible tasks. Such *messages and methods of hope* should therefore be documented and spread widely, since they not only inspire confidence that the goal of a hunger-free India can be achieved, but will also help build the self-confidence of all engaged in the mission of overcoming under- and malnutrition.

Basic approach: Food with Human Dignity

Food with Human Dignity should be the basic approach. The poor should not be subjected to a patronage approach and referred to as 'beneficiaries', but should be treated as partners in achieving the aim of ensuring that every child, woman and man in the country has an opportunity for a productive and healthy life. The right to adequate food and clean drinking water should be regarded as a basic human right.

Thrust of the Tenth Five-Year Plan (2002–2007)

The Tenth Five-Year Plan has shifted its emphasis from food security at the household level to nutrition security at the level of each individual. Emphasis has been placed on employment, education, health and nutrition, which are all important for poverty eradication and hunger elimination. The inter-sectoral nature of chronic hunger has been recognized. By shifting the attention to individuals, the strategies adopted will be based on the principle of *social inclusion* and will help to foster a life-cycle approach in nutrition interventions. For example, pregnant women will need special attention, since maternal and foetal undernutrition leads to the birth of babies characterized by a weight of less than 2.5 kg at the time

of delivery. Such LBW children suffer several handicaps in later life and may not be able to express their innate genetic potential for mental and physical development. Such inequity at birth is inexcusable, since we are now entering a knowledge-based economy. Similarly, old and infirm persons need special attention. Thanks to advances in preventive and curative medicine, we are now adding years to life. However, we should pay equal attention to adding life to years through nutrition and health care. We should recognize that we are now entering a new chapter in human longevity. Therefore there is need for a proper match between nutrition requirements and nutrition support at different stages in the life of an individual.

Hunger is the extreme manifestation of poverty, since the poor spend a high proportion of their earning on food. The elimination of hunger is thus the first requisite for eradicating poverty. Without adequate nutrition, the energy needed for higher work output will not exist in malnourished individuals.

Guiding principles for converting goals into accomplishments

Decentralization: The desired goal can be achieved speedily and surely only if a decentralized approach to implementation is adopted. 'Think, plan and act locally and support at the state and national levels' should be the motto. Elected local bodies together with the concerned Departments of Government (health, education, women and child welfare, rural and tribal development, etc.) should prepare *Micro-level Action Plans*. They should form a local-level *Alliance for a healthy and productive life for all*. Elected members of local bodies, particularly the one million elected women members can be empowered to spearhead the freedom-from-hunger movement, since they are more aware of the problems of nutrition and drinking water. Decentralization will enhance accountability, reduce transaction costs and remove corruption in delivery systems.

Life-cycle approach: For ensuring nutrition security at the level of each individual, a life-cycle approach is necessary so that the nutrition needs of an individual can be met from birth to death. Special programmes for adolescent girls, pregnant women, nursing mothers, infants (0–2 years), and old and infirm persons should continue. What is needed is the horizontal integration of numerous vertically-structured programmes. Such a functional integration will help create a symphony at the level of each village/town/city to ensure that all links in the food availability – access – absorption chain function at a high level of efficiency and effectiveness. Management tools and not additional momentary support will be needed to bring about at the field level, such convergence and synergy among ongoing programmes.

Information, education and communication: There is need for launching a Nutritional Literacy movement to spread awareness of the adverse consequences of malnutrition-induced intellectual and physical dwarfism among children. The Nutritional Literacy movement should include issues relating to food safety, *codex alimentarius standards*, sanitary and phytosanitary measures, etc. Mass media, particularly those in the public sector like Doordarshan and All India Radio can play a very important role in making the hunger-free India movement a success. Community Radio Stations, giving location-specific information, should be encouraged to assist other mass media in *spreading messages of hope*. It will be useful to set up Media Resource Centres for a Hunger-free India. Such centres can provide credible and timely information to the print, audio, video and new (i.e. internet) media.

Household entitlement card: It will be useful to provide every family with an *entitlement card*, giving information on the various government projects which it can access. The information may be disaggregated by gender, age, religion, caste and class, and precise addresses of contact persons and offices may be given. Such information will enable everyone to make the best use of their entitlements. A single step of this kind will help enormously to ensure the effective utilization of all the schemes of central and state governments and bilateral and multilateral donors.

Asset building and community development: The poor are poor because they have no assets like land, livestock or fish pond. They often are illiterate and lack proper dwelling. They survive on wage employment, which particularly in the case of women, does not reach the level of even the prescribed minimum wage. A massive effort is needed to help them shift from unskilled to skilled work through training in market-driven skills. The on-going micro-finance led self-help revolution will be the speediest way to help them rise above the poverty level. This will call for establishing effective forward and backward linkages, particularly with technology sources and markets. Insurance and Venture Capital support should also be available to micro-enterprises. We have now an opportunity to leapfrog in achieving our goal of enabling everyone to earn his/her daily bread.

Capacity building: Since a decentralized approach involving the empowerment of over three million women and men members of local bodies holds the key to the success of this national movement for food and clean drinking water for all, it is essential that a national consortium of Agricultural, Rural and Womens' Universities as well as government and non-governmental training and research institutions is formed for undertaking capacity building in areas such as management, communication and

organizational skills with reference to the implementation of the hunger-free area programme. The capacity-building programmes can be organized on a *Trainers' Training Model*, in order to achieve a multiplier effect.

Initiation of a National Food for Social Capital Programme

The social capital of a country is the product of interaction between the human capital and the cultural, political, economic, nutritional and natural environments. Human and social capitals constitute the most precious wealth of a nation. Mahatma Gandhi and Vinobha Bhave advocated the principles of *antyodaya* and *sarvodaya* for achieving high social synergy and capital. A society committed to building its social capital will try to promote programmes which represent a win-win situation for all, thereby avoiding winners and losers and the consequent social conflict and disruption. During the last few years, the Government of India as well as some state governments have initiated many programmes like *Sampoorn Gramin Rozgar Yojana*, *Annapoorna*, *Antyodaya Anna Yojana*, *Universal Noon-meal Programme for School Children*, etc. It is now clear that our farmers will produce more if we can enhance consumption and thereby opportunities for assured and remunerative marketing. Therefore, the initiation of a National Food Guarantee Scheme will help ensure that all who are hungry today due to lack of livelihood opportunities or other constraints, are able to have food for a productive life. Such a National Food Guarantee Scheme can serve as an umbrella for all ongoing projects like those mentioned earlier. In addition, it can provide food grains for initiating a *Nagarpalika Rozgar Yojana* as well as for a wide variety of social-support initiatives like Food for Health (TB, HIV/AIDS, malaria, etc.), food for those employed in ICDS, Nutritious Noon Meal and other similar projects. *In other words, food can become a powerful currency for achieving the goal of a hunger-free India.* Using food as a currency has twin advantages, namely there could be greater off-take of food grains from farmers, thereby providing them with an incentive to produce more, and secondly for meeting the immediate needs of the poor, destitutes, migrant labourers and all who are undernourished today.

The way ahead

India is rich in ecological, agricultural, cultural and climatic diversity. Amidst this diversity, there is also unity in terms of uncommon opportunities for enhancing through mutually reinforcing packages of technologies, services and public policies, the productivity, profitability, sustainability and employment intensity of major farming systems. Available scientific data indicate that the untapped production reservoir even with the tech-

nologies now on the shelf, is high in most of our farming systems. Therefore, progress in achieving a productivity revolution need not wait until new technologies become available. Integrated steps in the areas of soil health and fertility enhancement, water conservation and management, conservation and sustainable and equitable use of agro-biodiversity, and greater emphasis on post-harvest technology and agro-processing will help us leapfrog in agricultural progress and agrarian prosperity. Unity of goals but diversity of approaches based on local socio-cultural, socio-economic and agro-ecological conditions will be needed to achieve the desired goals.

Improving rural infrastructure and post-harvest technology are essential for further progress. Opportunity for assured and remunerative marketing has now become the most important component of agricultural progress. Another urgent need is effort to attract and retain youth in farming. The technological and skill empowerment of women in agriculture is vital for agricultural progress. There is rich traditional wisdom in relation to crop and animal husbandry, fisheries and forestry in different parts of India. It is essential to conserve such dying wisdom and blend it with frontier science and technology.

Symbiotic partnerships are vital for speedy progress and for the efficient and economic use of available resources. The partnerships could take the following forms:

Conservation and enhancement of natural resources and *access to technology and markets* will shape India's agricultural future. Enhancing technological capability and bridging the growing technological, gender and genetic divides are urgent tasks. Technology development and delivery have to receive equal attention. Farmer Participatory Knowledge Systems (FPKS) will be needed for this purpose. Such FPKS can help convert generic information (e.g. those relating to weather forecasts and market conditions) into location-specific action points.

Research, education and extension should have organic linkages. Advanced centres on the one hand, and *techniracy* (i.e. learning by doing) on the other, are needed. Personnel policies which can help attract and retain *youth in farming* are important. Both on-farm and non-farm employment need attention.

Strengthening the ecological foundations is essential for sustainable agriculture. Some ecosystems which need special attention are the following:

- Land: reclamation and restoration of wasted land.
- Sea-water farming for coastal-area prosperity.
- Biodiversity: Agro-biodiversity sanctuaries and implementation of Farmers' Rights.
- Mountain ecosystems: Eco-development and rehabilitation of hydrologic hot spots.
- Crop-livestock integrated production systems: animal nutrition and health.

Technologies that can help improve productivity, profitability, stability and sustainability of farming systems

need to be developed locally. Marker-assisted selection, genetic engineering, functional genomics, proteomics, information and communication technology, space technology and nanotechnology will also play an increasingly important role. Precision-farming techniques will have to be adapted to local conditions. Animal husbandry, inland and marine fisheries offer scope for improvement. Sea-water farming can help enhance coastal-area prosperity. Social prestige and recognition are vital to build the morale of both farm women and men and farm scientists, and to bring about the urgently needed productivity, quality and value-addition revolutions.

India is diverse politically, socially, ecologically and economically. Hence, a 'one-size fits all' prescription will be disastrous, as has become clear from many top-down programmes. We need to reverse the research and development paradigm and begin planning in consultation with farm women and men. Participatory research for developing location-specific technologies and participatory knowledge management systems are vital for bridging the gap between potential and actual yields with the technologies already available in the numerous ICAR institutes and agricultural and animal husbandry universities in the country.

Technologies should aim at three time dimensions –

- *Immediate:* Technologies already developed and available for immediate dissemination.
- *Medium-term:* Technologies in the pipeline which need testing, incubation and adaptation.
- *Long-term:* Strategic research aimed to develop new technologies through the use of the new genetics and other areas of frontier science and technology. Anticipatory research is also needed to meet potential changes in climate, particularly temperature and precipitation.

Science and technology are not magic wands with which hunger and poverty can be removed. However, they are

the catalysts of change and progress. Technology has been the prime-mover of economic progress in the industrialized world and hence technological empowerment of farm women and men is essential for moving agriculture forward. The tools of science and technology have to be tailored to solving the following problems:

- *Endemic hunger* caused by poverty and lack of access to balanced diets.
- *Hidden hunger* caused by the deficiency of micro-nutrients in the diet.
- *Transient hunger* caused by natural calamities or ethnic conflicts.

Every fourth farmer in the world is an Indian farmer. Over 700 million of our people live in villages. Public policies and public action should reflect this reality and bring about appropriate agrarian and aquarian reforms and an Indian Common Market. The Suresh Prabhu Committee should suggest, to start with, action plans for inter-basin sharing of water which represent a 'win-win' situation, both for human beings and the environment. This is the best tribute we can pay to the memory of J. R. D. Tata, who wanted India to be the leader and not just a follower in the fields of science, technology and sustainable development.

A few days prior to his assassination in January 1948, Mahatma Gandhi said, 'Forget the past, remember every day dawns for us from the moment we wake up. Let us all, everyone, wake up now'.

Let us wake up to the realities of the relationships between accelerated progress in the areas of agricultural production and food security, and national prosperity and sovereignty.

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