



**Institute of Rural Management, Anand**

**First Dr. Verghese Kurien Memorial Lecture**

**on**

**The Cooperative Pathway of Enhancing Rural Livelihood  
and Nutrition Security**

**by**

**Prof. M S Swaminathan, FRS**

UNESCO Chair in Ecotechnology and  
Member of Parliament (Rajya Sabha)

**Monday, 26 November, 2012**

**Anand 388 001**

**Gujarat, India**

# **The Cooperative Pathway of Enhancing Rural Livelihood and Nutrition Security**

by

**Prof. M S Swaminathan, FRS**

UNESCO Chair in Ecotechnology and  
Member of Parliament (Rajya Sabha)

I am grateful for the opportunity to deliver a lecture in honour of my friend of over 60 years – Dr Verghese Kurien. Much has already been written and said about his remarkable personal and professional qualities. What makes him immortal is the chain of Institutions he helped to build. IRMA occupies a pride of place among these “brain-children” of Dr Kurien. Capacity building for the professional management of Dairy Cooperatives was his passion. He worked hard to convert his dreams into accomplishment. Through the “Operation Flood” concept, he established a National Milk Grid consisting of nearly one lakh cooperatives. The Gujarat Cooperative Milk Marketing Federation and the National Dairy Development Board are some of the other gifts of Dr Kurien to the millions of milk producers in our country. He made “Amul” a household name and made this brand name synonymous with good quality milk. I am only sorry that his efforts to extend the power of co-operatives to the oilseed sector were thwarted by vested interests. Had his advice been heeded, we will not be importing today millions of tones of edible oil.

I must also add my homage to Shri Tribhuvandas Patel whose commitment to cooperatives Dr. Kurien inherited. In addition, I would like to pay my tribute and affection to the unsung heroine of the White Revolution, Mrs Molly Kurien, and to their daughter Nirmala and grandson Siddharth for the support they have extended to Dr. Kurien which he has often acknowledged as the source of his inner strength.

## **International Year of Cooperatives**

2012 has been declared by the United Nations as the “International Year of Cooperatives”. “Agricultural Cooperatives – Key to Feeding the World”, was the focal theme for this years’ World Food Day. Among the many serious problems we are facing on the food front is the gradual diminution in the size of a farm

holding. According to the Agricultural Census of 2005-06 the number of operational holdings is nearly 130 million. A majority of our farm families numbering about 120 million belong to the category of small or marginal farmers. The cost – risk – return structure of farming determines their ability to invest and to take to high value agriculture. A small farm itself is not a handicap since it affords an opportunity for taking to crop-livestock integrated farming systems, thereby increasing the net income per unit of land and water. A small farmer however suffers from many handicaps since new technologies, though size neutral, are not resource neutral, inputs being needed for output. Only by overcoming the constraints faced by small farmers, we can reap full benefit from small farms which are ideal for ecological farming. Therefore, a major challenge before Indian agriculture is the standardization of methods of providing the power and economy of scale to small producers.

The achievements of our dairy sector show that small scale dairy farming need not be a handicap if the technologies of production by masses and of mass production can be integrated in a suitable manner. In other words, decentralized small scale production, if supported by key centralised services, can help to increase the productivity and profitability of small farms. Today, we are the largest producer of milk in the world, thanks to the emphasis given by Dr Kurien to the processing and marketing of milk through Cooperatives. Even where Cooperatives are not successful, cooperation among groups of small farmers occurs based on the principle of enlightened self-interest. The success of the dairy industry is significant in human terms, since livestock and livelihoods are closely related in rural India. Also, the ownership of livestock is more egalitarian as compared to land.

### **Enlarging the Services Sector in Rural India**

A serious problem confronting our agriculture is the disinterest of the younger generation in farming and the consequent diversion of prime farm land for non-farm purposes. Some years ago, the Government of India launched a programme to enable farm graduates to start agri-clinics and agri-business centres. This

programme is yet to attract the interest of educated youth to the degree originally expected. It is hence time that the programme is restructured based on the lessons learnt. Ideally, a group of four to five farm graduates, who have specialised in agriculture, animal husbandry, fisheries, agri-business and home science, could jointly launch an agri-clinic-cum-agri-business centre in every block of the country. Agri-clinics can provide the services needed during the production phase of farming, while the agri-business centre can cater to the needs of farm families during the post-harvest phase. Thus, farm women and men can be assisted during the entire production cycle, starting with sowing and extending up to value addition and marketing. The multi-disciplinary expertise available within the group of young entrepreneurs will help them to serve farm families in a holistic manner. The Home Science graduate can pay particular attention to nutrition and food safety and help a group of farm women to start a food processing park. The group can also assist farm families to achieve the economy and power of scale both during the production and post-harvest phases of farming. Such an integrated centre can be named “**Agricultural Transformation Centre**”, attending to the felt needs of farming families in the areas of crop and animal husbandry, forestry and agro-forestry, inland and marine fisheries and agro-processing.

Opportunities for young entrepreneurs are several. Climate resilient agriculture is an area that needs inter-disciplinary attention. In dry farming areas, methods of rainwater harvesting and storage, aquifer recharge and watershed management as well as the improvement of soil physics, chemistry and microbiology, need to be spread widely. The cultivation of fertiliser trees which can enrich soil fertility and help to improve soil carbon sequestration and storage can be promoted under the Green India Mission as well as the Mahatma Gandhi National Rural Employment Guarantee programme. **A few fertiliser trees, a *jal kund* (water harvesting pond) and a biogas plant in every farm will help to improve enormously the productivity and profitability of dryland farming.** In addition, they will contribute to climate change mitigation.

The Agricultural Transformation Centre can also help women's self-help groups to manufacture and sell the biological software essential for sustainable agriculture. These will include biofertilisers, biopesticides and vermi-compost. The Fisheries graduate can promote both inland and marine aquaculture, using low external input sustainable aquaculture (Leisa) techniques. There is a growing demand for ornamental fishes. Feed and seed are the important requirements for successful aquaculture and trained youth can promote their production at the local level. They can train rural families in induced breeding of fish and spread quality and food safety literacy.

Similar opportunities exist in the fields of animal husbandry. Improved technologies of small-scale poultry and dairy farming can be introduced. *Codex alimentarius* standards of food safety can be popularised in the case of perishable commodities. For this purpose, the young farmers should establish *Gyan Chaupals* or Village Knowledge Centres. Such centres will be based on the integrated use of the internet, FM Radio and mobile telephony.

Among the services designed to meet the demand driven needs of farming families, important ones are soil and water quality testing and farm animal healthcare and nutrition. Young farmers can organise mobile soil-cum-water quality testing vans and go from village to village in the area of their operation and issue a **Farm Health Passbook** to every family. Farm Health Passbook will contain information on soil health, water quality, and crop and animal diseases, so that the farm family has access to integrated information on all aspects of Farm Health. Very effective and reliable soil and water quality testing kits are now available. This will help rural families to utilise in an effective manner the nutrient based subsidy introduced recently. Assistance can also be extended for helping to establish village level gene, seed, grain and water banks. Just as grain reserves are essential for food security, seed reserves are important for crop security, since if the crop sown at the beginning of the monsoon fails due to the onset of a prolonged dry spell, seeds should be available for sowing when the monsoon revives.

Young farmers can also operate climate risk management centres, which will help farmers to maximise the benefits of a good monsoon and minimise the adverse impact of unfavourable weather. They can help to introduce the benefits of information, space, nuclear, bio- and eco-technologies. Ecotechnology involves the blend of traditional wisdom and frontier technology. This is the pathway to sustainable agriculture and food security, as well as agrarian prosperity. **If educated youth choose to live in villages and launch the new agriculture movement, based on the integrated application of science and social wisdom, our untapped demographic dividend will become our greatest strength.**

### **Lessons from the Dairy Sector**

The achievements of the dairy sector provide many lessons to policy makers such as the following:

*First*, there is need for an end-to-end approach for ensuring the success of the dairy or other farm enterprises. Convergence in the provision of services relating to breeding, nutrition, healthcare and processing and marketing is an essential requirement for success. *Second*, a quality literacy movement should be launched to spread knowledge of *Codex alimentarius* standards for food safety as well as animal hygiene and sanitation. *Third*, Cooperatives should be professionally managed and authority and accountability should go together at all levels. *Four*, human resource development is important both at the farmer and professional levels. Farmer level capacity building can be done in Krish Vigyan Kendras, Vidya Dairies, as well as in the farms of outstanding dairy entrepreneurs (farmer to farmer learning). *Five*, public policies in the fields of import and export of animal feed (concentrates), input and output pricing and investment and infrastructure development should ensure the sustainability and survival of small scale dairy farming. *Finally*, the fact that women play a pivotal role in dairy farming should be kept in view, while developing support systems. Gender specific needs, such as creches for infants and medical help for adults should be met.

### **Nutrition Sensitive Agriculture**

The 2<sup>nd</sup> International Conference on Nutrition is due to be held in Rome in 2013 in the backdrop of the widespread persistence of under- and mal-nutrition in the world, particularly in the developing countries of South Asia and sub-saharan Africa. Many Nations are unlikely to achieve the modest UN Millennium Development Goal No.1, namely reducing hunger and poverty by half by 2015. Nearly 900 million children, women and men go to bed now partially hungry. Even in countries like India, where as early as 40 years ago an Integrated Child Development Service (ICDS) was introduced to deliver nutrition, healthcare and education in an integrated manner to children below 5 years of age, a recent survey reveals that in the 100 districts studied 42 percent of children under 5 are underweight and 59% are stunted. The Prime Minister of India, Dr Manmohan Singh, referred to this situation as a “national shame”.

It is clear but a business as usual approach will not help to remedy this unacceptable situation. Farmers constitute the majority of population in most developing countries and most of them operate small holdings, 1 to 2 ha in size. Malnutrition among such producer-consumers is an important cause for a large proportion of the population remaining malnourished. This is why the movement for spreading Nutrition Sensitive Agriculture assumes significance and urgency. We should make this movement environmentally, economically and socially sustainable and implementable. We must shift our attention from food security at the aggregate level to nutrition security at the individual level.

Nutrition Security involves physical, economic and social access to balanced diet (the needed macro and micro-nutrients), clean drinking water, sanitation, primary healthcare and nutritional literacy. **Nutrition sensitive farming involves the design and adoption of cropping and farming systems which can provide agricultural remedies to the prevailing nutritional maladies.**

Nutritional maladies may take the following forms

- **Protein-energy under or mal-nutrition**, primarily caused by poverty-induced lack of purchasing power
- **Hidden hunger** arising from the deficiency of micro-nutrients in the diet, such as iron, iodine, zinc, Vitamin A, Vitamin B12, etc

- **Transient hunger** arising from either natural calamities or civil disturbances including ethnic conflicts.

A Nutrition-sensitive agricultural system should be capable of addressing the above forms of nutrition insecurity at the household, community and national levels. Two research methodologies designed by me for this purpose are briefly described below:

- a) **Rural System Research (RSR)** RSR takes a holistic view of rural livelihoods – both on-farm and off-farm (Swaminathan, 1988). The major aim of RSR is to ensure food, work and income security to family farmers operating small holdings. Improving the productivity and profitability of small holdings in an environmentally sustainable manner, and generating opportunities for agro-processing and value-addition to primary products, as well as creating awareness for productive employment in the services sector are the goals of RSR. **Thus RSR will help to improve economic access to food and provide some insulation against price volatility.**

The RSR methodology can be operationalised through the **biovillage model** of sustainable human development. The Biovillage model of sustainable livelihood security involves the following three sets of action

- Conserve and improve the ecological foundations essential for sustainable agriculture, such as land, water and biodiversity
- Improve the productivity and profitability of the local cropping and farming system in an environmentally sustainable manner
- Generate avenues for non-farm employment through post-harvest processing and value addition and by enlarging the services sector.

When I was at IRRI in the 1980s, I had set up a Demonstration-cum-Training Farm titled, “Paddy and Prosperity”, with financial support from the Asian Development Bank. The normal saying in Asia is “Paddy and Poverty go together”. The aim of the BioPark is to reverse this perception and make paddy

an instrument of multiple sources of income. The components of the Rice BioPark include a demonstration of the potential for using the rice straw for a wide variety of purposes like mushroom production, paper manufacture, and ethanol extraction. To give an idea of the importance of biomass utilization, we produce in India over 250 million tonnes of rice biomass. However, in States like Punjab and Haryana, rice straw is burnt in order to prepare the field on time for wheat sowing. As reported in the media, one of the causes for the early onset of smog in Delhi is the practice of burning the rice straw in the field, leading to considerable air pollution and loss of valuable cellulosic material.

b) **Farming System for Nutrition (FSN)** This is a methodology designed by me to achieve science based marriage of nutrition and agriculture. It involves the following steps:

- Survey the village for nutritional deficiencies which need attention, as for example iron deficiency anaemia, blindness arising from the deficiency of Vitamin-A, goitre resulting from iodine deficiency and also health problems arising from the deficiency of essential amino acids like lysine. Based on the survey data and the food based opportunities available for overcoming the prevailing malnutrition problems, help farm families to incorporate the nutritional dimension in their cropping / farming system.
- Identify crops which can provide the needed nutrients. *Moringa oleifera* and sweet potato are excellent sources of micronutrient. Quality Protein Maize (QPM) can provide the needed lysine rich protein. In addition, pulses should find a place in the crop rotation. Crop-livestock integrated farming system should be promoted wherever possible.

Concerted efforts are now in progress to integrate nutritional factors in crop improvement research. For example, CGIAR's Harvest Plus programme aims to enrich staple grains with micronutrients like Fe, Vitamin A, Zinc, etc. Beta

carotene rich Sweet potato is another easily available source of Vitamin-A. Children like mashed sweet potato and the crop grows well under a wide range of conditions. Many of the major and minor millets are rich in protein. **Instead of referring to them as coarse cereals, they should be classified as “Nutri-cereals”**. Such minor millets are also more climate resilient and hence will become important in an era of climate change.

Public policy measures should help to enlarge the food basket so as to add nutrition-rich grains in daily consumption. An important step in this direction is being taken now. The Food Security Act recently introduced in Parliament, provides for the supply of highly subsidised grains to all individuals requiring social protection for meeting their dietary needs. In addition to wheat and rice, the Act provides for the supply of nutri-cereals to all needing social protection, at the rate of Rupee one per kg. It is hoped that such a step will enthuse farmers to take to the cultivation of a wide range of locally adapted millets as well as to crops like Quality Protein Maize.

Nutrition rich crop varieties are also being produced through the recombinant DNA technology (genetic modification). There are public concerns about GMOs and until such concerns are adequately addressed, genetically fortified crops bred by Mendelian methods or by Molecular Marker-Assisted Selection (MAS) could be used for overcoming the deficiency of micro-nutrients in the diet. There are biofortified crops in nature like *Moringa* and they can also be produced by breeding.

For promoting nutrition literacy, a woman and man selected by local communities can be trained as **Community Hunger Fighters** in every village. Such a programme initiated by the M S Swaminathan Research Foundation in the hunger hot spot area of Koraput in the State of Odisha, involves the training of a cadre of young women and men in providing agricultural remedies to the nutritional deficiencies prevailing in the area. The solutions suggested by the Community Hunger Fighters to the malnutrition problems of the area should be implementable, affordable, replicable and sustainable.

For spreading Nutrition Sensitive Agriculture, a decentralised approach will be needed. The RSR and FSN programmes should be tailored to the prevailing agro-climatic, agro-ecological and socio-economic conditions. The non-farm component of RSR should be based on a market-driven approach. Above all, women should play a lead role in all issues relating to balanced diet and good nutrition since they are generally incharge of household food security. Also, they play a lead role in animal husbandry, horticulture and post-harvest technology.

**2014 has been declared as the International Year of Family Farming by the United Nations.** After careful preparation during 2012-13, a global programme can be launched during 2014 on spreading the message and methods of Nutrition Sensitive Agriculture. All over the world, Farmers' Councils for Nutrition Security can be organised. Such Councils with the help of Community Hunger Fighters can become the flagship for a Nutrition Secure World.

### **Social Protection for Food Security**

Social protection has seen a sharp focus in the development policy agenda during the past decade (<http://www.fao.org/cfs/cfs-hlpe/en/>). There is also a clear trend for making social protection, as well as food security, "rights-based", rather than "discretionary". Yet, no clear consensus has so far emerged concerning many basic design choices and implementation modalities. The Food Security Act 2011 of India is designed to achieve the end of poverty-induced chronic hunger in our country. Food security can be achieved only through concurrent attention to food availability, access and absorption. Thus, it needs synergy between food and non-food factors, including clean drinking water, sanitation, primary healthcare and the needed purchasing power.

In the past, social protection started with the family, where an economically or physically disabled member used to be taken care of by other family members. Gradually, the joint family system gave way to small families, mainly comprising the husband and wife and their children. The absence of effective social

protection measures at the family and community levels is one of the causes of suicides among farmers observed in Vidarbha and elsewhere. Now that government is assuming responsibility for performing the duties that families and local communities used to undertake in the past, it is important to ensure that the social protection measures initiated by the government do not erode human dignity. Bread with dignity should be the motto for the social protection measures undertaken with public funds. In this context, I would like to quote from a recent editorial I have written in Science (November, 23, 2012)

### **Combating Hunger**

At the close of the recent London Olympics, the United Kingdom announced a programme designed to rescue 25 million children worldwide from malnutrition by the time of the next Olympics in Brazil. In May 2012, the World Health Assembly agreed to a target of reducing the number of stunted children by 40% (a reduction of about 70 million children) by 2025. To meet these targets and nourish the 870 million hungry people in the world ([www.fao.org/publications/sofi/en](http://www.fao.org/publications/sofi/en)), the world's leaders will need to prioritize an innovative science-based marriage of nutrition and agriculture.

The problem of hunger is not simply a lack of sufficient quantities of food. The chronic hunger caused by protein and calorie undernutrition is exacerbated by malnutrition (the “hidden” hunger caused by the deficiency of micronutrients, and sometimes by human diseases that disable the body's ability to absorb what micronutrients it receives. To address such intertwined problems, there must be synergy among national programs dealing with the availability, access to, and absorption of food. These nutrition security programs should be based on a life-cycle approach that starts with the “first 1000 days” from pregnancy to 2 years old, the critical period when stunting can cause irreversible damage ([reliefweb.int/report/world/nutrition-first-1000-days-state-worlds-mothers-2012](http://reliefweb.int/report/world/nutrition-first-1000-days-state-worlds-mothers-2012)).

In September, a High Level Panel of Experts to the United Nations (UN) Committee on World Food Security, which I chaired, released a comprehensive report on *Social Protection for Food Security*, with recommendations for

combating chronic childhood hunger ([www.fao.org/cfs/cfs-hlpe/en](http://www.fao.org/cfs/cfs-hlpe/en)). One of its recommendations—the concept of a “food security floor”—is particularly worthy of mention. The food security floor recognizes that freedom from hunger is a fundamental human right, defining the minimal steps needed for hunger elimination. These include nutrition literacy, clean drinking water, sanitation, and primary health care.

In some “hunger hot spots” of the world where agriculture is the backbone of survival, as in sub-Saharan Africa and South Asia, mainstreaming nutrition in agriculture programs is the most effective and low-cost method of eliminating malnutrition. This requires greater attention to the net income of smallholder farmers, whose women food producers have particular needs that require specific policies and support. As mentioned earlier, the year 2014 has been designated the International Year of Family Farming by the UN, and every effort should be made by developing countries to make every family farm a biofortified farm. We also should aim to train one woman and one man in every village in nutrition literacy to serve as Community Hunger Fighters.

The Olympic spirit stimulates efforts to achieve what may appear unachievable. There are already encouraging examples of speedy progress, with Brazil leading the way through its Zero Hunger (Fome Zero) program initiated in 2003 by then-President Luiz Inácio Lula da Silva, which has helped to cut the number of Brazilians living in extreme poverty by more than half. If synergy can be created among scientific know-how, political do-how, and farmers’ participation, it should be possible to achieve the goal of overcoming chronic and hidden hunger in large sections of the population of developing countries during this decade.

Access to food, irrespective of economic status is the major goal of the proposed Food Security Act 2011. Unfortunately, all the discussions surrounding this proposed law relate to eligibility criteria. Targeting aims to prevent the diversion of foodgrains to those who can afford to purchase them at market price. India is a vast country with diverse experiences. For example, Tamil Nadu operates a universal public distribution system (PDS) without any major implementation

difficulty. **Obviously a universal PDS will be successful only if it is based on the foundation of a culture of honesty.** It may be useful to introduce a universal PDS in the 200 high-burden districts identified by the Prime Minister's Nutrition Advisory Council on the basis of the severity of malnutrition. This will help us to monitor the impact of this programme.

In the area of absorption of food in the body, there is need for paying greater attention to clean drinking water. The Rajiv Gandhi drinking water mission needs to be completed soon so that there will be drinking water security in all our villages. In the area of sanitation, the scope of the sanitation mission should be enlarged so as to cover every village and town. There is also need for spreading sanitation awareness, since only a combination of education, regulation and social mobilisation will help to spread environmental hygiene and sanitary toilets.

Social protection in relation to food security has both intra-generational and inter-generational dimensions. The intra-generational dimension will cover the needs for all children and adults on a life-cycle basis. The inter-generational social protection measures should include steps to overcome maternal and foetal under-nutrition so that a new-born child has adequate birth weight (2.5 kg and above). Low birth weight children suffer from many disabilities in later life, including impaired cognitive abilities and diabetes.

An important cause of protein hunger in the diet of our people is the inadequate consumption of pulses, which often prove to be the major protein source in a vegetarian diet. The Government of India has provided funds in the Union budget of 2011-12 for setting up 60,000 pulses villages based on integrated attention to conservation, cultivation, consumption and commerce. This programme is being continued during 2012-13. The impact of such an end-to-end approach is evident from the fact that pulses production reached a level of 18 million tonnes during 2010-11, thus, breaking the era of stagnation in pulses production. Thus, there is hope for ending the protein hunger in our country.

## **Future of Genetically Modified Crops**

Dr Kurien was deeply interested in recent developments in biotechnology, with particular reference to improving milk yield. He however believed in the “hasten slowly” approach with reference to GMOs.

I was a contemporary of James Watson and Francis Crick at the University of Cambridge, UK, during 1950-52. I was aware of the fact that they were working on the molecular structure of DNA in association with Maurice Wilkins and Rosalind Franklin since I used to visit the Cavendish Laboratory to attend lectures by Prof Max Perutz. Their publication on the double helix structure of the DNA molecule appeared in Nature early in 1953 (Watson J D and Crick FHC, 1953. “A Structure for Deoxyribose Nucleic Acid” Nature, 171, 737-738) I was then at the Genetics Laboratory of the University of Wisconsin, Madison, USA. Since then, I have been following the explosive progress of the science of molecular genetics, opening up uncommon opportunities for transferring genes across sexual barriers.

In 1980, when I joined the Union Planning Commission at the invitation of the then prime minister Indira Gandhi, I set up a National Biotechnology Board to achieve synergy and coordination among the work in progress in molecular genetics and genetic engineering under the umbrella of different scientific organisations like ICAR, CSIR, ICMR, Department of Atomic Energy and UGC. I served as the first chair of the Board. Later, it was converted into the department of biotechnology during the tenure of prime minister Rajiv Gandhi, with S Ramachandran serving as its first Secretary.

During the last 30 years, the government of India has invested a considerable amount of money in creating the infrastructure essential for advanced research in the broad areas of biotechnology in general, and in genomics and genetic engineering in particular. The government is also hosting the International Centre for Genetic Engineering and Biotechnology (ICGEB) in New Delhi. Both in India and abroad, much investment has been made for human resource

development in the areas of environmental, medical, industrial, food and agricultural biotechnology. The first patent for a living genetically modified organism was granted to Anand Chakraborty in the US for his work on the development of a *pseudomonas* strain which can clean up oil spills. Genetic medicine including vaccine development is also making rapid progress. Bioremediation is gaining in importance with growing pollution of water. However, in the field of agricultural and food biotechnology, there are concerns about biosafety, environmental safety, biodiversity loss and food safety. The Global Biodiversity Convention adopted at Rio de Janeiro in June 1992 has the following clause with respect to biosafety:

“The Parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity.”

This resulted in the adoption of the Cartagena Protocol for biosafety. The Cartagena Protocol is the only international environmental agreement that is concerned exclusively with the transboundary movement (that is, trade) of products of modern biotechnology that are living modified organisms. It applies to the transboundary movement, transit, handling and use of all living modified organisms that may have adverse effects on the conservation and sustainable use of biological diversity, taking into account risks to human health. GM foods are considered only if they are LMOs that may be subject to transboundary movement for direct use as food, feed or for processing. The protocol does not apply to processed food products, nor does it address the food safety of LMOs that are for food, feed or processing. This Protocol was discussed in detail recently at Hyderabad on the Occasion of the Conference of Parties (CoP 11) of CBD.

In 2004, a committee set up by the Ministry of Agriculture of the Government of India under my chairmanship (Report of the Task Force on Applications of

Agricultural Biotechnology, May 2004, ministry of agriculture, government of India) made several recommendations of which the following is important:

“The bottom line of our national agricultural biotechnology policy should be the economic well being of farm families, food security of the nation, health security of the consumer, biosecurity of agriculture, protection of the environment, and the security of national and international trade in farm commodities”. Recently, the committee on agriculture of parliament, headed by Basudeb Acharya with 31 members of parliament drawn from both the houses (Lok Sabha and Rajya Sabha) and from all political parties has submitted a very detailed report on “Cultivation of genetically modified food crops: Prospects and Effects” (Lok Sabha Secretariat, August 2012, 492 pp).

The committee has unanimously recommended that “till all the concerns voiced in the report are fully addressed and decisive action is taken by the government with utmost priority to put in place all regulatory, monitoring, oversight, surveillance and other structures, further research and development on transgenics in agricultural crops should only be done in strict containment, and field trials under any garb should be discontinued forthwith”. The committee also suggested, “What the country needs is not a biotechnology regulatory legislation but an all encompassing umbrella legislation on biosafety, which is focused on ensuring the biosafety, biodiversity, human and livestock health, environmental protection, and which specifically describes the extent to which biotechnology, including modern biotechnology, fits in the scheme of things without compromising with the safety of any one of the elements mentioned above. The committee, therefore, recommend to the government with all the power at their command to immediately evolve such a legislation after due consultation with all stakeholders and bring it before parliament without any further delay. In this context, the committee would advise government to duly consult the Norwegian Law, which emulates this spirit to a large extent”. A Technical Expert Committee (TEC) constituted by the Hon Supreme Court of India has recommended “Based on the current overall status of food safety information on Bt transgenics including the data on Bt cotton and Bt brinjal examined by the

TEC and in accordance with the precautionary principle, the TEC recommends a ten year moratorium on field trials of Bt transgenics in all food crops (those that are directly used for human consumption).”

Can we take advantage of the beneficial aspects of recombinant DNA technology by greater investment in public good research, as for example in the breeding of crop varieties whose seeds farmers can keep and resow, rather than concentrate only on hybrids whose seeds the farmers have to buy every crop season? How can we develop institutional structures, which can help to allay the apprehensions of the public? This is the most urgent task facing the central and state governments today with reference to genetically modified crops. The sooner we address the issues raised by the parliamentary committee, the greater will be the opportunity for harnessing molecular genetics for sustainable food security.

### **Strengthening the Science-Society Interface**

The Royal Society of London, one of the oldest science academies in the world, established about 25 years ago, a committee on public understanding of science (COPUS). Later, the Royal Society also constituted a committee on political understanding of science. In a democratic society like ours, there is greater need for public and political understanding of the scientific facts underpinning events of great significance to our future, such as, biodiversity loss and climate change. Recent examples in relation to differences in perception and apprehension are in the areas of genetic engineering and nuclear energy.

While medical biotechnology has not generated fears about biosafety and environmental safety, food and agricultural biotechnology has evoked strong opposition. An area in medical biotechnology, which is controversial, is cloning. Generally, therapeutic cloning is acceptable, while reproductive cloning is not. In the case of crop biotechnology, the fears relate to biosafety and environmental safety, adverse impact on biodiversity and long-term impact on human and animal health. The impact of Intellectual Property Rights (IPR) in relation to inclusiveness in access to new technologies is also a matter for public concern.

The controversy relating to Bt brinjal and the moratorium on its release imposed by the then minister for environment and forests are examples of the lack of confidence in the existing regulatory procedures. The Supreme Court of India has also raised several issues of public importance with reference to genetically modified crops and foods. Several state governments have imposed a ban on the testing of GMOs. The Kerala government has not allowed even the testing of genetically modified rubber, although we urgently need rubber clones tolerant to higher temperature. Obviously, powerful scientific innovations like nuclear power generation and genetic modification require professionally led regulatory structures. The government of India has developed a Biotechnology Regulatory Authority Act for being discussed in parliament. The standing committee on agriculture of parliament headed by Basudeb Acharya has recommended that we should adopt a comprehensive Biosafety Act. The aim of the Act is to provide a professional and transparent regulatory body, which inspires public, political, professional and media confidence.

Another recent example of the need for greater interaction between scientists and local communities is the concern expressed by the public in relation to the Kudankulam and other nuclear power plants. Nuclear power is environmentally benign since it does not add to the green house gas burden. On the other hand, there are concerns about the safety of the nuclear power plants, particularly in the context of what happened at Chernobyl many years ago and Fukushima recently. The tsunami induced Fukushima tragedy has given a big setback to the spread of nuclear power plants. Nuclear waste disposal is another area, which needs careful consideration. The situation observed at Kudankulam where technical experts and the general public have been living in different worlds, emphasises the need for fostering continuous interaction between technical experts and the local communities. Such interaction and conversation should begin from the very early stage of the conception and construction of a nuclear power plant. **Citizens' Consultative Councils** will help to promote more enlightened and informed discussions on the issues involved. Parliament has recently approved an Atomic Energy Regulatory Authority Bill. The bill provides for an autonomous and professionally credible and competent regulatory body.

It is obvious that a regulatory body should not be under the control of the persons to be regulated, which was the case until recently. Ultimately, regulation alone will not be adequate for achieving public acceptance. Education and social mobilisation through elected local bodies are equally important.

As science progresses, more and more such issues of public concern will grow. Nanotechnology will also create fears and apprehensions. The role of scientists in the area of public information and education will increase. We need a cadre of science communicators possessing both proficiency in science and mastery of communication. I am reminded of Prof C V Raman who used to deliver lectures for school students on topics like, “Why the Sky is Blue” or “Structure of Diamonds” with great clarity and lucidity. I have seen thousands of young students listening to him in pin drop silence, digesting every word and idea that he expressed. I would suggest that our universities should help in developing science communicators who can explain to the general public in local languages, the significance of important scientific discoveries. Biodiversity, biotechnology, nuclear technology and nanotechnology need priority attention in efforts designed to bridge the scientist-society perception gap.

Nanotechnology is an area where proactive action is needed to remove doubts in public mind. The following quotation from a recent issue of Nature (August 30th, Volume 488, p.557) brings out the urgency of attending to societal concerns as will be clear from the following quote:

“In the past two years, Mexican nanotechnology researchers have been subject to a spate of bombings and bomb threats. In the worst of the attacks, two researchers were injured. Police say that if the explosive had gone off properly, a whole building could have collapsed. Nanotechnology advocates have an important role here, and one that could help to determine how public awareness of nanotechnology develops. They should continue to work to make public debate informed and accurate, and do more to monitor and test the possible toxicity of novel products. And they should avoid hype. If they paint a true

picture of the state of the science, then the distorted version drawn by the extremists will have a greater chance of being recognised as such”.

No wonder, in a recent Editorial in Science (August 17th) Alan L Leshner has made the following remarks:

“Public understanding and support of science and technology have never been more important, but also never more tenuous. Today, they are embedded in an increasingly politicised environment where ethical, legal, and social implications are emerging at a rate that seems to be outpacing society’s capacity to make sense of the science. The **science of science communication** will be essential to help guide new and more effective efforts at engaging productively across the science/society interface.”

### **Nurturing Dr Kurien’s Legacy**

Dr Kurien and his mentor, Shri Tribhuvandas Patel have shown through their work in the Dairy Sector, that rapid progress will be possible only if technology development and the social engineering aspects of technology adoption are given concurrent attention. In this field, the graduates of IRMA have an important role to play. You have unique opportunities today to bring about both a small farm management revolution and the technological transformation of the agrarian economy. Prime Minister Lal Bahadur Sastri, who requested Dr Kurien to organise and head the National Dairy Development Board rightly coined the slogan, “Jai Jawan, Jai Kisan”. Dr Kurien converted the concept of “Jai Kisan” into reality by calling himself as “an employee and servant of the farmer”. In contrast, the farmer is usually referred to as a “beneficiary” in government programmes. Farm men and women seldom find a place in the list of Padma awardees. Over two thirds of our population remain unseen and unrecognised. A mind-set change is essential for giving farmers the respect and gratitude which both Lal Bahadur Sastri and Dr Kurien extended to them. After all, we should recognise that we live on this earth as guests of sunlight and green plants and of the farm families who convert them into food. We are the true beneficiaries of their toil in sun and rain.