

Indian Agricultural Development in Changing Scenario – Past, Present and Future¹

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Indian agriculture is the largest private sector enterprise in the country of over 110 million farmers. It engages two-third of total workforce, contributes to 26 per cent of the GDP and nearly one-sixth of the total export earnings. India inherited a stagnant agriculture at the time of independence growing at an annual rate of growth of 0.3 per cent in the first half of the last century. Due to the planned Government policies, technological support provided by agricultural scientists and hard work put in by the farmers, Indian agriculture has achieved an annual growth rate of 2.7 per cent in the post independence era. During the decade of 1980's the growth in food grain production was most impressive at about 3.7 per cent compared to population growth of 2.2 per cent. Unfortunately, it slowed down in nineties to 1.8 per cent, lower than the population growth of 2 per cent. Further, within the agriculture sector too, the development has been uneven in production and productivity across regions and crops.

All said and done, over-riding the three-fold growth in population by a four time increase in food grain production from the beginning of the first five year plan to the turn of the century is by all means a commendable achievement. The key macro indicator of national achievement in agriculture comprised a quantum jump in food grain production from 50.8 million tons in 1950-51 to 212 million tons in 2000-2001. It is worth noting that 92 per cent of the increase in production has been technology-led. Thanks to the agricultural scientists for developing need based technologies and heads off to the hardworking Indian farmers for their receptiveness to ideas, willingness to adapt and also adoption of new and improved scientific knowledge. Of course, appropriate policy planning and project execution at all levels by the government provided platform for such a massive achievement. This revolution not only became the national pride as crusader against hunger and poverty but also a model for the developing world. Nevertheless, it is time to work to produce more diversified

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and quality food at affordable price to meet the requirements of the ever increasing population and also improve the living standards of people.

There is a great deal of concern that during 1990s the growth of agriculture has decelerated as compared to 1980s. A Planning Commission study indicated that the overall growth rate of crop production declined from 3.72 per cent per annum in 1980s to 2.29 per cent in 1990s. Similarly, productivity fell from 2.99 per cent per annum to 1.2 per cent. Analysing separately food grain and non-food grain crops, it is seen that the deceleration in the growth rate of food grain was steep and it fell from 4.02 per cent to 2.83 per cent during that period. This apart, the productivity of our crop commodities continue to be much lower compared to other major crop producing countries. This must draw our serious attention now. It may be worth sharing that during the last three decades, the production increase was ushered by use of high yielding varieties of seed, assured supply of water and intensive use of chemical fertilizers and pesticides. These have their own limitation and problems. For example, calculations show if the desired growth rate in agriculture of around 4 per cent is to be achieved through the currently accepted technology mix the per hectare fertilizer consumption will have to increase to 186 kg/ha in 2011-12 from the current level of 76 kg/ha. Such a level of chemical fertilizer intensity may be undesirable for both environment and productivity reasons. Similar question may bother our minds for other inputs. Can biotechnology or other technologies could be an answer or at least part of the answer to the problems? These are to be addressed.

The factors responsible for low productivity could largely be, research breakthrough in restricted few crops, growing disparity between potential yields due to improper technology transfer mechanism, low productivity from rainfed crops, low input use and also low input use efficiency, lack of food processing and value addition to horticultural and vegetable crops (2 per cent of total produce), high post harvest losses especially in horticultural produce (20-40 per cent), very low agricultural produce export (1 per cent of global export), poor market infrastructure, untrained human resource in agriculture sector especially as entrepreneurs and skill workers. Special efforts need to be made to raise the productivity and production of crops, livestock, fisheries, horticultural crops to ensure food and nutritional security for the people and generating surplus for export keeping in view the fact that India has a great competitive advantage in agricultural export.

2. Sustaining the Development

The rapid change in Indian Agriculture particularly since the era of green revolution has been received with mixed response. The development perspective has been definitely encouraging and viewed positively by almost all sectors. However, at the same time, the conservative view has echoed the need for the

system sustainability, which may also be arguably right. Both viewpoints have complementarity and also distinct application values, which need to be accepted. Therefore, one should always look forward to addressing both sustainability and development in Indian agriculture in the years to come.

The changing scenario has recorded agriculture more as a business proposition than merely tradition at least in the agriculturally progressive states. The traditional agriculture, which was a way of life of the majority of Indian farmers, has gradually shrunken to fewer pockets. It is rightly believed that the traditional farming was consistent for cropping patterns, mixed crop composition, cultivation practices, etc., and it was based on the hereditary and the community level experiences. This way of agriculture harboured several friendly and synergistic biota, including, earthworms and soil micro-organisms. The non-biological resources were equally nurtured, for example, the soil structure, composition and organic matter content. In terms of subsistence, the traditional agriculture ensured the farming families more or less self-sufficiency because of an array of harvests even though individual commodities harvested were little in quantities. The farmer did not have to pay for these commodities in the local market. Rather they sometimes earned a little profit by selling their marginal surplus in the weekly haats.

However, the developmental pursuits led by the improved technologies have been affecting the traditional agriculture in terms of both content and extent. This is mainly because of the economic consideration wherein traditional farming has gradually become uneconomic and obsolete. Modern agriculture became commodity or market oriented wherein direct commercial benefit was the main criteria for choice of crop grown by a farmer. The needs of the progressive farmers for commodities other than their main crop(s) that would have been ordinarily met from the traditional mixed farming plots obviously had to be fulfilled from extrinsic sources. Further, in order to organize progressive farming, farmers have to invest in several inputs, such as, tools and farm machinery, improved quality seeds, fertilizers, pesticides, post-harvest processing yards and sheds. As a result, their financial needs for primary investment have been on an increase. This required more production and income. Thus, the economics and financial considerations became increasingly important, including the costs, returns, markets and profits.

The technological break-through in agriculture has also given way to diversification in several ways; with non-traditional crops, new varieties of crops or new methods of cultivation although in terms of nutritional security, the former group is most important. Also, multiple farm enterprises, such as crops, dairying, and poultry, are important from the perspective of both economics and diversification. With the ever-increasing population, rapid urbanization, growing external markets, and more and more demands for farm products competition is also likely to increase. This obviously requires emphasis on fair and efficient regulatory mechanisms and the elaborate legal protection of farmer entrepreneurs and innovators.

In India, crop-livestock mixed farming is traditional. Most of the traditional systems are highly efficient and self-sufficient, and thus are sustainable. The combination of livestock with crop production is an effective risk aversion mechanism, developed out of generations of experience of farmers in arid and rainfed areas. The system is a very good example of recycling of all farming byproducts and household waste with little dependence on outside resources. This is an appropriate and sustainable approach for remote rural areas, where outside resources or services are accessible with great difficulty.

However, there is need to understand production systems and to assess the scope and priorities for development interventions. In semi-arid regions, the combination of trees, cereal crops, leguminous pulses and oilseeds along with a mix of livestock, i.e., cows, buffaloes and goats is common. Each of these is adopted with a multi-purpose objective. Trees provide fruit, fodder and fuel, and some trees improve the soil or serve as windbreak. Crops provide food, fodder and fuel, and leguminous crops improve the soil. Most preferred fodder crops are leguminous species grown in the winter and rotated with cereal crops; thus they provide a much needed protein source for the animals. Livestock are a source of food, fuel, manure, draught power and ready cash in emergency. Thus, these are surely movable assets and investment with social value. Each component has multipurpose value although it is usually assessed singularly.

Similarly, in tribal areas, the combinations generally seen are trees, cereal-legume mixed cropping, cows and/or goats and poultry. These farming systems have developed on the perceptions of men and women farmers, tribals and agropastoralists over the generations. It has been observed that in the semi-arid to arid areas or when the rains fail, income from livestock is the main farm income. In tribal areas, small ruminants replace the livestock, which is semi-domesticated rather than being stall-fed. Further, in the better rainfall areas, there is shift towards buffalo. The majority of tribal families, and the underprivileged community in general, rear poultry in the traditional backyard system. The main developmental concern in these systems, however, is the verification of improved local technology and its delivery system.

Several increasing problems have been associated with the adoption of new technology to enhance returns from traditional farming. There may be the problems of, for example, soil and water management, choice of crops, technical know-how, pests and diseases, natural hazards, marketing, finance, surplus production, price fluctuations and several more. The challenge is to develop technologies and packages that may improve productivity and production in a sustainable, environment enriching and energy efficient manner but without competing for human food. An important ray of hope, which one can notice in this complex changing scenario of agriculture, is that at least there is a new generation of farmers who are more educated, young and energetic. They could be keen on getting more knowledge about the new technology while carrying forward the family farming traditions more rationally and also logistically.

3. Emerging Issues and Challenges

Ever increasing human and livestock population particularly in the under developed and the developing world is negating the technology driven progress in agriculture. Global human population was only 1 billion in 1800 A.D., doubled by 1930 and touched 3 billion mark by 1960. It took only 39 years to double itself again by 1999. It is estimated that by 2100 AD, human population will touch the 12 billion mark. Most of the predicted future increase in population will be in the developing countries of Asia, Africa and Latin America. Similarly, in case of India where population is increasing continuously, it is predicted that Indian population will stabilize around 1.4 billion by 2025. The population increased @ 1.9 per cent per annum from 1995 to 2000, and the rate of growth is likely to be around 1.8 and 1.6 per cent per annum during the period 2000-2010 and 2010-2020, respectively. To meet the food demand of the population the yield level is required to be enhanced substantially and also sustainably. This has to be viewed in the present scenario when the emerging issues like, agriculture becoming less remunerative because of fall of prices of major agricultural produce in recent years, surplus production of food grains in last 6-7 years, liberalized economy under post WTO scenario driving towards commercialized agriculture, less attraction of youth to agriculture profession, lack of efforts to agriculture for employment-led growth in rural areas, mismatch between agricultural education and agricultural occupation etc.

Natural resources like soil and water are continuously degrading both in quality and also in quantity. Soils are being constantly degraded and over-exploited. As per FAO estimates, only 11 per cent of the earth's surface has no limits on its use for agriculture. Nearly 28 per cent is too dry, 23 per cent has chemical imbalances, 10 per cent is too wet, 6 per cent is permanently frozen and remaining 22 per cent is constrained by shallow depth. About 70 per cent of the Indian soils are deficient in organic carbon (less than 1 per cent) and micronutrient deficiencies are being widely experienced throughout the country. Soil toxicity due to industrial effluents and use of chemicals and pesticides is affecting adversely both soil health and crop productivity. Ever increasing menace of land degradation and population pressure have forced the farmers to cultivate even on marginal lands.

Water is another important vital resource for economic development. At the global level, three-fourth of the earth's surface is covered with water and the total water resources amount to 1385.5 million km³, comprising 97.3 per cent as salt water and 2.7 per cent as fresh water. Of the latter, 75.2 per cent occurs as polar ice and glaciers, 22.6 per cent as ground water, 1.9 per cent as soil moisture and atmospheric vapour, and 0.3 per cent in lakes and rivers. This indicates that very limited water is available for domestic, industrial and agricultural use. Fresh water is finite but renewable through continued hydrologic cycling. India is one of the most well-endowed countries in terms of

annual rainfall and has about 4 per cent of the world's fresh water resources. It is projected that the present per capita per annum water availability of 2001 m³ will reduce to stress level of 1700 m³ in the next 2 to 3 decades. Further the projected reduction in water availability to the agricultural sector from the present share of 89 to about 75 per cent by 2020 would adversely affect our capacity to produce more food. Future gains in agricultural productivity depend upon integrated development and utilization of surface and ground water resources. The indiscriminate use of canal water is leading to waterlogging and salinization in the major irrigated commands. The increased ground water extraction has declined water table at an alarming rate, putting an additional burden on farmers in terms of investments, equipments and energy. Further, it is estimated that even after achieving the full irrigation potential, nearly 50 per cent of the total cultivated area will remain rainfed in the country.

Wide variety of ecological habitats in the world support an enormous diversity of flora and fauna. Out of 10 hot spots of biodiversity in the world, two are in India in the Western Ghats and North-Eastern region. India has about 8 per cent of the total existing plants and animals of the world. A survey conducted in the Himalayan region in the altitudinal range between 1800 and 3599 m showed that the area under traditional species has declined from 85 per cent in 1970 to 55 per cent in 1990. The factors responsible for erosion of biodiversity are; monocropped agriculture, introduction of traditional crops to non-traditional areas, introduction of irrigation in desert ecosystems, increased pace of land degradation such as salinity and indiscriminate use of chemicals. The issues of climate change and global warming caused by the emission of greenhouse gases have emerged as new thrusts. It is projected that South Asia may have an increase in temperature between 0.1 and 0.3°C by 2010, and 0.4 and 2.0°C by 2070. The sea level is expected to rise between 15 and 24 cm over the next century and the lowlying areas may get inundated. Moreover, the ozone depletion may lead to increase in ultraviolet radiation and will result in adverse impact on earth's environment. One of the dominant concern in the 21st century will be of nutritional security. It is reported that almost half of the pre-school children suffer from moderate to severe malnutrition. In addition, vitamins and micronutrient deficiencies have become widespread. People suffering from these maladies are largely concentrated in rural areas and urban slums. Other than their own labour, they hardly have any resources and skills.

Another challenge before us is to transform the present institutions into new agricultural institutes characterized by different work culture, responsiveness and cost-effectiveness. There is a need to build a knowledge-based system. We must use information technology as an instrument of research as well as knowledge sharing. Such efforts would provide us a platform for innovative partnership both nationally and globally. Other challenges are: How do we use "new age" capacities to strengthen the web of relationships among farmers, consumers, civil society institutions, scientists and policy makers?

These are not rhetorical questions, but are at the core of our quest for a prosperous future and new society.

The other major concern is to strengthen our position as producers of public goods in order to serve the poorest of the poor, as well as those who are needy among the developing countries. But the task is complex, especially due to new developments such as increased involvement of private sector, intellectual property protection and emergence of international regimes including WTO, that may restrict free flow of information and materials. We should find new and creative ways of working with our expanding clientele such as the private sector, NGOs, Farmers' Associations etc. We obviously have a challenging journey ahead for which we need to gear ourselves.

I believe that the most crucial issue before us is to continue building human resource in order to compete globally and serve the diverse needs of the society. Emerging challenges will require a new breed of scientists and managers that have excellence in the field of new sciences such as biotechnology, information technology, environmental science, Geographic Information System (GIS), space science, health and other natural sciences. The strength of an organization/system is determined not by mere numbers but by the technical competence of its human resource. Hence, the HRD should be seen as a long-term investment in the interest of global community.

Globalization, as a consequence of WTO, linked with the international trade liberalization, opening up of economies, and a free flow of capital, labour, information and technology is a major paradigm shift making significant changes in the world economy. It has a considerable potential to significantly influence both the food/nutritional security and poverty for better or worse, but its implications and consequences are not yet fully understood.

The other concern is to ensure increased and secured funding for Science and Technology. To increase productivity and growth for ensuring better living standards and to reduce poverty and malnutrition, funding support for agricultural research will have to be stepped up to a minimum of 2 per cent of agricultural GDP as is the case with many growing economies of the world.

4. Needs and Approach

Given its range of agro-ecological setting and producers, Indian agriculture is faced with a great diversity of needs, opportunities and prospects. Most importantly, growth needs to be more rapid, more widely distributed and better targeted in order to reduce the absolute number of people living in poverty and to reduce regional imbalances. In responding to these challenges, more efficient and sustainable use will have to be made of increasingly scarce land, water and germplasm resources. The well endowed irrigated areas which account for 37 per cent of the country's cultivated land currently contribute to about 55 per cent of agricultural production, it is projected that a significant part of the further

required increases in production will still have to come from these areas. However, of late, deceleration in production and of factor productivity growth in some of the major irrigated production systems, such as the rice-wheat system, have been recorded. Those areas in which yields from Green Revolution technology are already high will have to rise total factor productivity and break through the present yield ceilings, which for the major food grains are often below those of East Asia. Rainfed agriculture, which covers 63 per cent of the total cultivated land and, accounts for only 45 per cent of agricultural production in these less favourable areas, yields are not only low but are also highly unstable and technology transfer gaps are much wider as compared to those in irrigated zones. Areas where productivity lags will have to be brought closer to their existing productive potential. All areas where rainfed farming is dominant – whether in the central plains hills, semi-arid or coastal lands – will have to contribute more to poverty elevation, and augment food security by producing marketable surplus more reliably.

While addressing the issues of productivity, it will be necessary to address growing environmental concerns, especially natural resource conservation. These include the need for better conservation of the land and water base of irrigated agriculture, a reduction of agro-chemical pollution and adverse health affects, protection of fragile eco-systems in mountain, coastal and arid areas, and the containment of deforestation by traditional shifting cultivation.

The following strategy elements are suggested for promoting towards sustainable agricultural development and environmental conservation at the farm community level in low-potential areas.

- Perception of the environment as fundamental to present and future livelihoods.
- Development of labour-saving and time-saving technologies for fuelwood and water collection, food preparation and post-harvest storage.
- Substitution, where possible, of farm-grown inputs which make little demand on household finances, such as integrated pest management, biological nitrogen fixation, organic waste recycling and composting, and biogas production where feasible.
- Creation of non-farm income opportunities to support, not undermine, sustainable farming systems.
- Search for other means of supporting household livelihood when common access to resources such as grazing land leads to increase degradation of the resource.
- Improvement of linkages between researchers and their target group of farmers and rural people to develop sustainable agricultural technologies for marginal lands and smallholders, and also develop suitable transfer of these technologies to users.

- Adoption of policies that seek to fill those gaps in the food system of critical importance to poor people in low resource areas, such as post-harvest technology to avoid food loss, agroforestry, decentralized marketing, better biomass utilization, alternative sources of income generation, which require the development and dissemination of improved agricultural technology.
- Encouragement of the integration of tree-growing in farming systems, as well as the integration of fuel, fodder and fuelwood systems.
- Better environmental monitoring (satellite predictions, remote sensing) to improve planning and assessment of land and water resources.

High-potential areas require many of the management and conservation measures described for low-potential areas; but they can generally sustain intensive cropping using existing technologies, if care is taken to maintain the soil's regenerative capacity and external inputs such as agrochemicals are carefully managed. In general, these areas are either irrigated or have reliable, adequate rainfall and good soil fertility.

Besides above, following reorientation suggested for future policies need to be addressed

- Invest more in research and extension and increase farmer input and feedback into technology generation and the dissemination process.
- Shift fertilizer policy from an emphasis on increasing the level of use to improving efficiency of nutrient balance and timing and placement of fertilizer.
- Shift crop protection policy from dissemination of chemical pesticides to use of integrated pest management.
- Shift emphasis in irrigation policy from investment in new systems to improvement of water-use efficiency and productivity in existing systems.
- Adopt appropriate economic incentives through price policies that keep domestic prices in line with long-term world price trends.
- Reform trade and macroeconomic policy regimes that penalize agriculture to stimulate production by improving short-term input-use efficiency and encourage long-term investment and technological change in the agriculture sector.

The contemplated view lay heavily on improvement in efficiency and incentive-driven production and trade which is quite rational. In addition, resource and situation-based harmonization on a changing time scale say increase in fertilizer use, creation of additional irrigation facilities, price policies keeping in view the need of equity and social justice, would be rewarding.

The central issue in sustainable agriculture is not achieving maximum yield. It is long-term stabilization. Sustaining agricultural productivity will require more than a simple modification of traditional adhoc techniques. The requirements of sustainable agro-ecosystems clearly are not only biological or technical, but are also social, economical and political and illustrate the requirements of a sustainable society. Ecological change in agriculture cannot be promoted without comparable changes in all other related areas of society. The final requirement for ecological agriculture is an attitude towards nature of coexistence, not of exploitation. We need to specifically focus on the following

- Increasing agricultural productivity and production to ensure food and nutritional security and generating surpluses for exports
- Developing areas of untapped potential, thereby correcting uneven development of agriculture across regions
- Addressing problems of under-employment, unemployment, poverty and malnutrition in the rural areas
- Diversification of agriculture and accelerating the development of horticulture, sericulture, animal husbandry, poultry and aquaculture with necessary processing and marketing back up
- Increasing flow of resources and augmenting the rate of capital formation in agriculture
- Focussing the agricultural research system on the development of economically viable and location-specific low cost technologies and harnessing research in frontier areas of science and technology for the benefit of all sections of the farming community
- Addressing technology transfer and training needs of farmers in the post WTO scenario
- Arresting degradation and depletion of national resources and maintenance of ecological balance and sustainability of use of resources
- Increasing the utilization of irrigation potential, promoting water conservation and efficient water management and expansion of irrigation facilities specially in the drought prone areas
- Revitalizing and democratizing cooperatives for providing credit, inputs extension support and marketing and processing facilities
- Promoting value addition in agriculture and providing strong market support for disposal of agricultural produce
- Correcting the terms of trade to make them favourable for agriculture
- Promotion of exports of agricultural commodities and integration of Indian commodity markets with global markets

- Pursuing land reforms to channelise the energies of small and marginal and women farmers to increase agricultural production
- Creating quality consciousness among the farmers and agro-processors and promoting standardization and grading agricultural products for better marketability of the products.

5. Strategies for Agricultural Development

(i) Raising Yield Level in Low Productivity Area: Very large proportion of area under various food crops fall under low productivity category (57 per cent in coarse cereals to 92 per cent in oilseeds). Their yield levels are about 40 per cent less than in high productivity areas. For instance, in rice and wheat the yield level in low productivity areas are respectively 2538 and 2032 kg/ha as against 2867 and 3828 kg/ha in high productivity areas. About 60 of such low productivity areas are in the states of Bihar, Orissa, Assam, West Bengal and U.P. for rice and 68 per cent in the states of U.P., M.P., Bihar and Rajasthan for wheat.

(ii) Cultivation of Waste and Fallow Lands: Over 24.5 million ha remaining as waste land and 16.6 million ha as fallow lands. Similarly, about 8-10 million ha of saturated soils remaining least exploited in the rainfed lowland areas of eastern India. There is scope to bring under cultivation sizeable of this large unutilized area through soil amendment and introduction of crop choices in the wastelands and moisture conservation measures, development of facilities for life saving irrigation wherever feasible and introduction of crop species/varieties matching the available water balance in fallow lands.

(iii) Bridging the Yield Gap: Yield gap analysis reveals that sizeable potential of these crops is yet to be fully tapped. Differences between experimental and farmers' yields are quite wide. Equally the gap is wide between potential and realizable yields. For instance, in rice about 40 per cent of the potential available in the present day high yielding varieties is still to be exploited. Same holds true in other crops as well. What is required to achieve such yield targets by diagnosis and correction of factors constraining the yield increase. Insulation of all future varieties with desired level of resistance to key pests and diseases and tolerance to major abiotic stresses like salinity, drought, temperature extremes etc. could be the priority research option to consolidate the genetic yield potential achieved already in the plant type based varieties and hybrids.

(iv) Raising Productivity of Rainfed Crops: Even if the ultimate irrigation potential of the country is realized, about 50% of the cultivable area may continue to be rainfed. Since vagaries of weather affect production from drylands and thereby the stability of the food production in the country, strategic research on rainfed agriculture may be a priority area, to insulate the farmer from high risk-proneness of dryland farming. Watershed development for

raising productivity of rainfed crops, improvement of agricultural credit; insurance cover for risk prone areas and crops and marketing facilities are some of the areas which need more attention.

(v) **Integrated Nutrient Water and Pest and Disease Management:** It will be in the national interest to lay greater emphasis on agricultural system productivity rather than on production targets. For maintenance of soil fertility on a sustainable basis in intensively cropped areas greater emphasis has to be placed on residue management legumes as inter crops for gains (residues for soil incorporation) and/or green manures, inoculation technology etc. Rationalization of use of chemical fertilizer nutrients is important in improving nutrient use efficiency in cropping systems. For efficient nutrient use there is a need to adapt fertilizer practices with residue management and water availability particularly in the rainfed areas as indicated by long term weather forecasting. Excessive use of pesticides has made the pest management increasingly difficult because of the new problems such as pest resurgence and pesticide resistance. Pollution of environment and pesticide residues at toxic levels in the food chain are the other problems associated with indiscriminate use of pesticides. The need for judicious and rational application of fertilizer and pesticides is being address through Integrated Pest Management (IPM) which includes pest monitoring, promotion of biological control of pests, organizing demonstrations and training of extension workers and farmers specially on crops such as rice, cotton, oilseeds, etc. by coordinating institutional and universities resources. The main idea is to adopt and promote environmentally safe and cost effective plant protection that harmonises with other segments of crop husbandry for achieving higher crop productivity.

(vi) **Eco-regional Approach:** There are many routes to rapid agricultural growth. Either through the expansion of land area with relatively low technology which is rather limited or primarily through yield-increasing technology or by changing the composition of production, and in particular from the rapid growth of agricultural exports. In this scenario, eco-regional planning will have to aim at enhancing agricultural productivity and production on a sustainable basis to meet the ever-growing needs of the farm family and the livestock for food, feed, fodder, fuel, fibre etc. This would call for an effective collaborative mechanism, i.e. responsibility for a higher level of integration in research and development efforts. In the eco-regional approach to research and management of natural resources, a balance in development and utilization of biodiversity would be important.

(vii) **Availing Export Potential:** In the last few years India is emerging as a leading exporter of agricultural produce, both, fresh and processed till now the Indian agriculture had been guided by the pressing demand for food. Fortunately, with the concerted efforts on part of agricultural scientists and the farmers and with generous government support, we were able to overcome domestic food deficits and in the years to come, agricultural development in the

country would be guided not only by the compulsions of improving food and nutritional security, but also by the concerns for environmental protection, sustainability of production and supply as well as profitability of farm enterprises. Following the General Agreement on Trade & Tariffs (GATT), liberalization process and globalization of markets would call for competitiveness and efficiency in agricultural production, and the agriculture sector will have to face a challenging situation on the ecological, climate, economic, equity, social justice, energy and employment fronts. This is an opportunity for enhancing productivity through improved input efficiency and also enhancing the quality of product through improved varieties and also through value addition.

6. Epilogue

Reducing the number of hungry people presents two challenges: ensuring access to food now plentiful and increasing productivity on sustainable basis to ensure removing poverty. Low agricultural productivity also needs to be addressed, particularly in marginal ecological regions with poor soils and high climatic variability. The dramatic gains of the green revolution have bypassed these areas. A doubly green revolution is needed – one that increases productivity and improves environmental sustainability. Increased investments are needed to research and develop better technologies and disseminate them through extension services. So are investment in infrastructure, such as roads and storage systems. The changing scenario has recorded agriculture more as a business proposition than merely tradition atleast in agriculturally progressive state. Globalisation, as a consequence of WTO has a considerable potential to significantly influence and, therefore, its consequences are to be fully understood. The agricultural development has not to address only to the internal food needs but also to world market needs and ecological issues, and be highly competitive. Indian agriculture as a part of the world agriculture system, has to keep pace with fast and vastly changing technologies, new products and product varieties, expanding and complicated information systems, new market strategies, new services and so on. Tomorrow's Indian farmer will have to wear a global outfit, he has to be different from himself to take up the challenges. The role of knowledge and skill is paramount, education holds the key to all these emerging pre-requisites. The task is highly challenging but at the same time offers an opportunity to capture the opening and promote agricultural products in national and international trade through enhanced productivity and better product quality. Let us accept it and prepare ourselves to meet future challenges.