Challenges to food security in India

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The need for achieving food security is felt significantly in the recent years due to enormous pressure from the ever-increasing population in India. Owing to the change in preferences in crop production techniques over a period of time, several new challenges draw attention to food security. This article discusses various challenges to food security in India. Critical analysis is made on challenges like crop diversification, issues related to bio-fuel and medicinal plant cultivation, climate change, mismatch between water demand and availability, recent status in production of high-yielding crop varieties and agricultural crop pricing and insurance and new trends in globalization and urban encroachments.

Keywords: Challenges and threats, crop production, food security, globalization.

GLOBAL food security will remain a worldwide concern for the next 50 years and beyond. There has been no significant jump in crop yield in many areas stressing the need for higher investments in research and infrastructure, as well as addressing the issue of water scarcity. Climate change is a crucial factor affecting food security in many regions including India. The most important thing one has to keep in mind is that some of the technologies relating to crop production which were found to be innovative and quite relevant in the yesteryears might need refinement in the present context as far as food security is concerned. For example, higher use of chemical fertilizers and pesticides was recommended earlier to attain the higher food grain production. However, after realizing the potential ecological hazards caused by them, we slowly started advocating controlled use of fertilizers and pesticides. The concepts of integrated nutrient management and integrated pest management have attained significance in the context of sustaining soil fertility and environmental protection. However, the realization of crop yields may take longer under these sustainable agricultural technologies. Hence, to ensure food security, the following challenges have to be addressed as discussed here.

Crop diversification

In the successive years of green revolution when food security was fulfilled at national level due to stupendous efforts of ICAR, the emphasis of agricultural scientists has been put on implementation of crop diversification. This was advocated to the farmers for two main reasons. First, the prices of food grains like rice and wheat were not encouraging and farmers ended up with very low net returns even during years of bumper production. By concentrating on other crops like cotton, chilli and sunflower the farmers were encouraged to earn higher profits. Second, the productivity of rice and wheat was poor in some regions like uplands and dry lands due to high moisture stress sensitivity of these crops. Hence by encouraging farmers to diversify to oil seeds and pulse crops and high-value medicinal plants which require less quantity of irrigation compared to that of field crops, they would certainly get higher profits.

The trend of temporal change in area share of the crops in India revealed that the area under cereals (expressed in percentage of gross cropped area) has been found to be declined from 56.53 in 1991 to 51.74 in 2008 (Table 1). Similarly, the area under pulses has also come down from 23.74 in 1991 to 22.77 in 2008 making the area under food

Table 1. All-India temporal change (%) in the area share of main crop and crop groups, 1991 to 2008 (from Srivastava[20])

Crop	Area (million hectares)	
	TE 1991*	TE 2008
Cereals	103.68 (56.53)	99.01 (51.74)
Pulses	23.74 (12.94)	22.77 (11.90)
Oil seeds	24.2 (13.24)	26.97 (14.09)
Fruits	3.09 (1.68)	5.54 (2.89)
Vegetables	5.17 (2.82)	7.48 (3.91)
Spices	2.26 (1.23)	2.47 (1.29)
Gross cropped area	183.42 (100.00)	191.36 (100.00)

Figures within parentheses are share in gross cropped area.
*For fruits, vegetables and spices data pertain to triennium ending (TE) 1993.

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grains decline. The area under oil seeds during the same time period has enhanced from 24.2 million hectares to 26.97 million hectares. An increase in proportion of area under fruits, vegetables and spices was also witnessed during the same period.

The need of the hour is to prioritize the preferential crops that suit well under each agro-climatic region of the country so that higher net returns can be achieved by the farming community through crop diversification. The options for combining crop component with animal component such as integrated rice-fish farming may be explored which would result in additional net returns to the farmers without affecting the food security[1].

Bio-fuel and medicinal plant cultivation

One of the main reasons for food security crisis at global level is the diversion of agricultural lands that were used for cultivating maize and wheat to bio-fuel and medicinal plants in the United States and other European, Asian and African countries. The recent preference for cultivation of sugarcane and other field crops for production of ethanol is certainly considered to be a big challenge for the food security of the world. At the same time, there has been considerable increase in cultivated area of medicinal plants like amla, ashwagandha, sarpagandha and bio-fuel crops like jatropha witnessed in India in the recent years. For example, the cultivated area under amla was reported as 100,000 ha in India and it occupies about 40,000 ha in South India itself[2]. In Tamil Nadu, the cultivated area under amla was found to be increased from mere 46 ha in 2000 to 9020 ha in 2011 which reflects the higher rate of increase in terms of crop diversification[3]. In several instances, it was recorded that the traditionally productive regions for cultivation of food crops like rice and wheat were converted to medicinal and bio-fuel crops, which is really alarming in the context of food security. Hence, there is a strong necessity of regulating the amount of land area and nature of land that can be diversified for this purpose.

Climate change

Food security is severely influenced by climate change. The changing climate will influence the food grain production in different ways. For example, the temporal and spatial variations in precipitation including rainfall may result in deficit moisture stress, i.e. drought or excess moisture stress condition, i.e. flooding. Similarly, extreme high or low temperatures result in variations in the length of crop growing season. These factors would also affect the crop productivity and farm net income and hence climate resilient agricultural practices have to be promoted. This is applicable to all the nations, including India. Understanding the impact of climate change on Indian agriculture is quite complex as several factors are involved in this phenomenon. For example, the negative effect of global warming on crop productivity in India may be compensated by carbon fertilization to some extent. Several researchers conducted studies on the interrelationship between climate change and food security in relation to impacts of climate change on crop productivity, food production and socio-economic aspects. Gregory *et al.*[4] based on their experiments conducted on wheat and rice reported that global warming would result in decreased crop duration. It is already established that some factors of climate such as increased carbon dioxide level would play a positive role in enhancing crop productivity. However, the crop productivity would be negatively influenced by changes caused by extreme variation in temperature and nutrient interactions and higher rate of natural disasters such as floods and droughts[5–7]. The fourth assessment report (AR4) of The International Panel on Climate Change predicted an increase in global temperature by 2–6°C by the year 2100 which is alarming[8]. The expected crop yield due to climate change can also be predicted over a period of time through modelling. Jones and Thornton[9] conducted study on the simulations of maize production in Africa and Latin America based on the climate data derived from the HadCM2 model and an overall yield reduction of 10% was predicted by 2055.

The changing climate affects food security at the global level as it brings remarkable changes in land utilization pattern and water resource availability[10–12]. At the same time, increased human interference may fasten the changes. It was reported that ever increasing human population coupled with their changing dietary preferences significantly increased global demand for food and thereby generating tremendous pressure on native vegetation and ecosystems[13]. India also faces a similar grim situation in tackling the issues related to food security and policies related to globalization further affected the environmental health stressing the need for regulation of the same.

Though climate change related agricultural research has been focused on assessing the response of various growth parameters of crops due to specific changes in climate, accurate analysis of food security indicators could not be achieved which reflects the vulnerability of food systems to global climate change (Figure 1). This is due to the fact that the individual assessments in general study climate variability without any integrated approach as they mainly focus on bio-physical aspects of production only. As a result, the food accessibility and food consumption elements of food security get little attention. There is an urgent need to address the food security concerns that are central to economic and sustainable development issues in both India and the other nations which is possible by integrating bio-physical and socio-economic aspects of food systems.

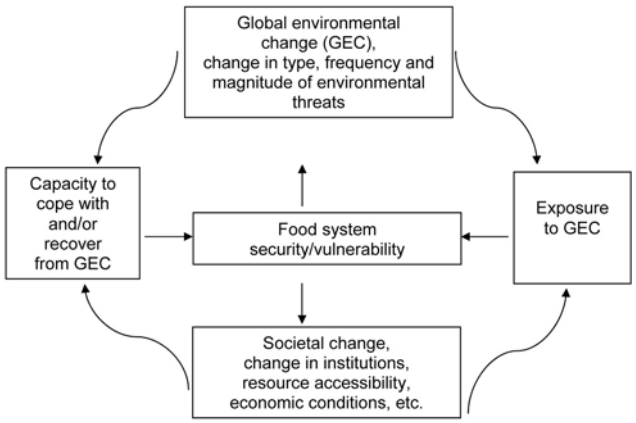

Figure 1. Factors determining the vulnerability of food systems to global environmental change (from Gregory *et al.*[21] and Ingram *et al.*[22]).

Climate change in the recent years has resulted in higher frequency of floods and droughts, making the objective of attaining food security very complex. Hence, the future research efforts related to management aspects of tackling vulnerability caused by natural hazards must consider the social, economic and geo-political constraints. Enhancing the resilience of human systems to cope with extreme climatic stresses should become the main objective. There is a strong need to address changes in institutions and resource accessibility to tackle the climate-induced natural hazards[14]. Overall, the agricultural practices have to be reoriented which would provide better climate resilience and enhanced net farm income.

The capacity of people to cope with climate change and its related edaphic changes varies from one region to another in India[15]. The study also suggested that an integrated approach is highly essential to address the food insecurity concerns. On the basis of specific problems faced by the farmers, the approach should be different. For example, in the western IGP, food systems are most vulnerable to problems such as excessive irrigation coupled with rising water tables and soil salinity, whereas in the eastern IGP, problems such as rising sea level and increased risk of flooding are generally witnessed and farmers have little capacity to tackle them. Hence, it can be stated that food security can be achieved by tackling the specific challenges related to climate change in diversified regions.

Mismatch between water demand and availability

Because of tightening supply and rapid expansion in demand, freshwater is expected to emerge as a key constraint to future agricultural growth and food security[16]. Globally, the demand for water has grown annually by 2.4%. About 20% of the globally cultivated area is irrigated, utilizing an estimated 70% of the global water use and accounts for nearly 40% of the total food production. Only 10% of the water is used in homes and 20% by the industry. Gross water demand for all users in India is expected to grow up from 750 BCM in 2000 to 1027 BCM by 2025. The gross water demand by irrigation sector alone is estimated to be 730 BCM by 2025. The total water received annually in India is about 4400 km^3, from precipitation and inflowing rivers which originate outside the country. India's share of water at the global level is about 4.2%. Currently, only 29% of the total precipitation is conserved and water-use efficiency seldom exceeds 40%. India has 143 million ha of arable area, of which 63 million ha is irrigated. About half of the irrigated area in our country receives water through exploitation of groundwater. The number of countries experiencing water stress is expected to be 50, including India by 2025 with a total population of three billion people. Among the developing countries, India is projected to have the largest absolute increase in water withdrawals between 1995 and 2020. Total annual renewable freshwater available in India has been assessed as 2085 BCM. Per capita water availability in India is expected to go below the water-scarce threshold level of 1700 m^3 within the next two decades (projected to decrease to 1500 m^3 by 2025 with wide inter-basin variations). Hence, the mismatch between the expanding demand for and supply of water emerging and spreading steadily over space and time will have serious implications for meeting the food production growth targets and food security in India. Efforts must be made to strike an optimum balance between the demand and supply of water resources for ensuring food security in India.

Production of high yielding varieties: need for higher momentum

The challenge of food grain production is generation of sufficient number of new varieties of field crops with threshold potential in changing climate scenario. Several varieties of rice and wheat were released, but still exists a gap between the yield obtained through these genotypes and their field level performance. One of the main issues might be the genetic potential exploitation has attained saturation according to the climatic and edaphic conditions that existed in India. For some crops like rice, the hybrid varieties developed resulted in yield jump but the magnitude has not been achieved like the scenario in China. The poor harvest index of pulses and oil seeds also remains a challenge to the plant breeding programmes. In some of the problematic soils, the varieties with full yield potential in normal situation cannot fit well resulting in poor crop productivity. This situation has to be corrected by employing modern biotechnology techniques. In several regions of India, farmers are not able to get information about the availability of new and

improved varieties and some are not having access to quality seeds of these varieties, resulting in lesser yields. This situation has to be corrected by developing a national-level network to monitor and coordinate the activities with the various State Government and Central Government functionaries working in the area of crop production.

Agricultural pricing and crop insurance issues

The farmers in India face severe problem in marketing their crop produce after harvest due to lack of remunerative prices for the end-products. Several times, the farmers are forced to opt for distress sale leaving them in a vulnerable condition due to poor market prices. It is really unfortunate to find some section of farmers' vulnerability to higher cost of cultivation accompanied by the unreasonable market prices. The situation is alarming in case of pulses like black gram, green gram and red gram, and commercial crops like cotton, tobacco and chilli. Globalization has brought openness in trade, but it could not ensure better market prices. Hence there is a need to regulate the agricultural marketing policy for the welfare of the farming community, which in turn would facilitate food security in India. The Commission for Agricultural Costs and Prices (CACP) may decide the policy related to market prices of crops in India, in a manner which would fetch better returns to the farmers. CACP presently determines the level of minimum support prices of different agricultural crops by taking into consideration factors like cost of production, changes in input prices, input–output price parity, trends in market prices, demand and supply, inter-crop price parity, effect on industrial cost structure, effect on cost of living, effect on general price level, international price situation, parity between prices paid and prices received by the farmers and effect on issue prices and implications for subsidy. In this context, it is heartening to note that the minimum support price for cereals like rice and wheat, and pulses like black gram and green gram has been enhanced in the recent years. However, with the significant increase in cost of cultivation of food grains, the enhancement of minimum support prices at frequent intervals would be highly essential. Otherwise, the farmers may shift from cultivation of cereals and pulses to non food grain crops, which certainly poses a severe threat to food security in India.

Natural hazards like floods and droughts occur frequently in India challenging crop productivity and food security. Hence the farmers must be provided with comprehensive crop insurance policy so that in the event of unforeseen climatic aberrations like cyclones and floods, they would be provided with compensation. Though Government of India has initiated efforts for providing crop insurance to farmers since independence, a major boost was given in the form of Comprehensive Crop Insurance Scheme (CCIS) in 1985 during the Seventh Five Year Plan period, which covered the risk in cultivation of major crops against natural calamities and pests and diseases[17]. The National Agricultural Insurance Scheme (NAIS) which is also known as the Rashtriya Krishi Bima Yojana replaced CCIS in 1999–2000. NAIS operates in all States and Union Territories of India. Insurance coverage and financial support to farmers would be given in the event of failure of any of the notified crops as a result of natural calamities, pests and diseases. NAIS is implemented by the Agriculture Insurance Company of India Ltd (AIC) and the scheme helps the farmers to adopt new and innovative farming practices and scientific modern technology. It is promoted by General Insurance Corporation of India, National Bank of Agriculture and Rural Development (NABARD), United India Insurance Company Limited, National Insurance Company Limited, Oriental Insurance Company Limited and The New India Assurance Company Limited and it is directly controlled by the Ministry of Finance, Government of India. The number of farmers covered under NAIS has increased from 9.08% in 2000 to 15.95% in 2007. Similarly, the percentage of gross cropped area covered under insurance has enhanced from 8.73 in 2000–2001 to 14.58 in 2007–2008, which is significant.

New trends in globalization

Though globalization undoubtedly brought several positive changes like technology development and transfer, faster communication and transport and higher growth in the services sector, it has also resulted in challenges like more volatility in the financial markets and severe competition among the entrepreneurs and growth inequity among various sections of the society. One of the consequences of globalization in India is the openness in trade. Thus, the rich have access to initiate global ventures where the poor would restrict themselves to localized works. As the protective policies are discouraged in post-globalized world, the poor have little opportunity to compete with the rich leading to inequality and this concerns to food security in India.

The implications of globalization for a national economy in India are quite remarkable. Globalization has certainly intensified interdependence and competition between economies in the world market, which is clearly reflected in new course of trading in goods and services. As a result, economic development in India is not determined exclusively by its domestic policies and market conditions. Moreover, they are influenced by both domestic and international policies and economic conditions. In other words, this would restrict the policy options available to the government and also results in loss of policy autonomy to some extent at the national level. The impact

of globalization in India culminated in the establishment of special economic zones (SEZs) which also led to widening the gap between the rich and poor sections.

Urban encroachments (special economic zones)

A SEZ can be defined as a specifically demarcated zone that is provided with special economic and other privileges over the regular industrial firms in a specific region for facilitating production of trade and services. SEZ receives special and preferential treatment from the government. SEZ can also be categorized as a specially identified geographic area within the territory of a country where economic activities of certain kinds are promoted by smooth policy provisions and special incentives that are not generally provided to the other regular firms.

The concept of SEZ is not completely new to India. The earlier forms of SEZs were referred as export processing zone (EPZ), free trade zone (FTZ), etc. The first EPZ in India was established in Kandla in 1965. The Special Economic Zone Act 2005 came into force from 2006. Recently, the concerns were expressed regarding the loss of significant cultivated area, due to establishment of SEZs. As the policy stresses on the utilization of uncultivated area for the operation of SEZs, care must be given to grant the permission for SEZs without affecting the prospects of food security in India. In recent times, the issue of SEZs has drawn national attention, particularly since early 2007 due to the mass resistance in some regions of the country.

No doubt, SEZs have been given the permission to hasten export growth rate and economic growth rate of the nation in the era of globalization and liberalization. In addition to trade and investment, the SEZ policy is an instrument that paves the way for deregulation of governmental control and modifications in the tax regime. The SEZ Act also provided a single-window facility to simplify the process for obtaining the necessary permission. The implementation of SEZ Act made it necessary to make certain amendments in other acts. The Land Acquisition Act of the Ministry of Rural Development has certain provisions for acquiring new lands for the establishment of any enterprises, including SEZs. The Government of India initiated a move in the form of new land acquisition bill to incorporate additional provisions for ensuring better compensation and rehabilitation package for the affected people[18].

No doubt, the SEZs in India have resulted in the generation of additional economic activity and promotion of export of goods and services. It is reflected from the significant growth rate of physical exports (381%) from SEZs from 2003–04 to 2007–08 (Table 2).

It has also helped in creating additional employment opportunities, higher investment from domestic and foreign sources and development of infrastructure facilities. As a result, the foreign domestic investment also exhibited tremendous rise in India.

However, there is a concern that the establishment of SEZs involves a huge amount of revenue loss to the government in terms of relaxation of taxes and duties. As SEZs would be given exemption from the normal laws of the land related to labour rights and municipal governance, it may lead to some inequalities in the society. This may challenge the growth equity principle which hampers the objective of food security in India. Moreover, the SEZs would involve acquisition of large tracts of rural areas leading to massive eviction and displacement of rural folks and their loss of livelihood in addition to diversion of cultivated land for non-agricultural purposes. For example, in the case of Polepally SEZ in Andhra Pradesh, several farmers have lost their farmlands turning them to either small landholding farmers or landless[19]. Out of about 358 farmers at the time of prior approval of the SEZ, 166 lost their farming occupation due to operation of SEZ. In addition, several farmers lost their livestock and irrigation facilities such as bore wells, which resulted in higher rate of migration and food insecurity.

Table 2. Trend of physical exports from Special Economic Zones (SEZs) in India from 2003–04 to 2007–08 (from http://www.sezindia.nic.in[23])

Year	Value of physical exports from SEZs (Rs crore)	Growth rate (% over previous year)
2003–04	13,854	39
2004–05	18,314	32
2005–06	22,840	25
2006–07	34,615	52
2007–08	66,638	92

Conclusion

Overall, it may be concluded that food security in India can be achieved by paying higher attention to issues such as climate change, integrated water management, agricultural pricing and crop insurance. The impact of globalization in the form of SEZs and other factors has been both positive and negative in terms of agricultural prosperity and there is a strong need to regulate the policies related to globalization for reducing its negative effects on food security in India.

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