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Seema Shukla*, Surya Prakash Singh and Ravi Shankar

Department of Management Studies,
Viswakarma Building, Shaheed Jeet Singh Marg,
IIT Delhi, New Delhi 110 016, India
Email: seemasanjaishukla@gmail.com
Email: surya.singh@gmail.com
Email: ravi1@dms.iitd.ernet.in
*Corresponding author

Abstract: In India, the growing population has put tremendous pressure on the economy. The most important concern of this millennium is to feed the ever growing population. Several countries are working on the Millennium Development Goals (MDGs) to achieve food security for their citizens, and in the same line, recently India has passed the Food Security Bill: 2013, which assures every citizen a right for quality food. This paper is an attempt to study the technologies available and their applicability on the betterment of agricultural practices including production, harvesting, distribution and storage and their impact on achieving food security. The existing structure of Public Distribution System (PDS) in India and role of technology in improving the current PDS to ensure food security are examined. The paper also identifies the aspects related to lack of food safety control on some of current technological practices. The paper identifies the areas in agricultural practice and distribution system where technology can have large impact. The paper further identifies the need for development of regulatory system, policies and communicating it to relevant stakeholders. There need to reach out to people and involve participation globally to avoid duplication of work.

Keywords: food security; technology; agriculture; sustainable; biotechnology; nanotechnology; food safety; agriculture extension; information technology; public distribution system; PDS.

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Biographical notes: Seema Shukla received her MTech degree from G.B Pant University of Technology, Pantnagar with specialisation in Food Biotech Engineering. She has around 14 years of experience in quality assurance, auditing, consultancy, training and research. She is a Qualified Lead Auditor and Trainer on food safety and also worked as a Consultant Administrator and Policy Maker. She is currently working as an Assistant Director at Export Inspection Council of India, Ministry of Commerce and Industry and pursuing his PhD degree from IIT Delhi.

Surya Prakash Singh is an Associate Professor in the DMS, IIT Delhi, India. He holds a PhD from IIT Kanpur. He is also a Post-Doctoral Fellow from SMA, NUS, Singapore-MIT USA alliance. His research interest lies in facility layout problems, heuristics, and meta-heuristics. His work has been published in leading international journals such as *IJPR*, *LNCS*, *IJAMT*, *EJM*, *RBR*, *IJRTE*,

and *APMR*. He regularly reviews articles for many leading journals. His biography appeared in Marquis, USA Who's Who in Science and Engineering, December 2007, and Who's Who in the World, November 2010. Recently, he has been awarded Young Outstanding Faculty Fellowship from IIT Delhi.

Ravi Shankar is a PhD from IIT Delhi, India. He has over 30 years of teaching and research experience at Indian Institute of Technology Delhi (IIT Delhi) at Department of Management Studies, Asian Institute of Technology, Thailand (School of Management), Regional Engineering Colleges (now NITs) at Allahabad and Jamshedpur, and Delhi University. He has co-authored over 250 research papers in leading journals. Also, he is associated with a large number of Business Schools across globe as Visiting Faculty, etc. primarily in the area of Operation and Supply Chain Management. He is the Executive Editor of *Journal of Advances in Management Research*.

1 Introduction

In human civilisation, it is the primary need of an individual for the survival to have the appropriate quality and quantity of nutritious food. The biggest challenge in developing countries is to provide food security to their countrymen. The UN has identified Food Security as one of the Millennium Development Goals (MDGs). The first MDG, out of eight, is to eradicate extreme hunger and poverty which has a high dependency on agriculture to feed the ever increasing population of the world. The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". Commonly, the concept of food security includes both physical and economic access to food to meet the dietary needs of the population. The food chain starts right from the selection of seed at the field to harvesting till it reaches to the table of consumers. In many countries, there are many health problems related to dietary excess and in other countries problems like malnutrition and food borne diarrhoea further add to the existing burden. There is a need to improve and apply technological advancements at each stage of food production, processing and distribution system across the world.

The current average annual growth rate of 1.114% is increasing the world's population by 75 million a year (US Census Bureau, 2005). Most of the population increase (appx. 90%) is occurring among the developing countries of the world. Approximately, half of the world's annual population growth occurs in just six countries, namely, India, China, Pakistan, Nigeria, Bangladesh and Indonesia (Joseph, 2004). According to the Food and Agriculture Organization (FAO) estimation, the number (around 75 million) of the undernourished people in the world has increased in last few years. The main reason attributed to the same is high price of the commodity and low purchasing power in many underdeveloped and developing countries (FAO, 2008). There has been sharp shift in the international food security debate in 1980s to the 2000. The real concern is not just the shortage of food production but there are more complex set of issues like price hike, population explosion, accessibility of the quality products, depletion of natural resources. Therefore, to maintain current levels of food availability to the increasing population, it will require rapid production increases without destroying natural resources, which in turn requires application of technology. According to the

World Health Organization (WHO) 2008, around 854 million people worldwide were estimated to be undernourished. Millions of more people are being driven into poverty and hunger owing to high food prices. While the risk of increased food and nutrition insecurity may be more pronounced in urban areas, where people rely exclusively on market and tend to be vocal about their needs, they are of particular significance in rural areas, too, where 75% of the poor reside and where a large percentage of poor rural households are net-buyers of food. The majority of poor people living in villages or country side rely on agriculture activities and therefore, agricultural practices pave the way for economic growth in poorer nations. Agricultural and rural development is a broad indicator of economic and social development that the MDGs emphasise. The systematic use of science and technology significantly boost the agricultural production. This was exploited in the twentieth century to achieve Green Revolution in the world. The initiative of Green Revolution in the year 1945, was supported by Rockfeller foundation and the Mexican government, further support of World Bank resulted in the spread of such revolution across all parts of the world including India. Green Revolution was an effort of science and technology which included a series of research, development and technology transfer initiatives to increase the yielding varieties and disease resistant grains, improved irrigation facilities, modernised infrastructure and use of fertiliser and pesticides. India became food deficient to food sufficient country after Green Revolution. However, there exist associated problems with the Green Revolution including loss of biodiversity, monoculture cropping patterns, stability of the eco-system contamination of the natural resource water and several health issues due to overuse of the chemicals.

New ways and technology are required to feed around 1.2 billion population of the India which have huge variation in their purchasing capabilities. In the year 2013, Indian Government has passed Food Security Bill popularly referred as 'Right to Food Act' with an objective to provide subsidised food grains to eligible families below poverty line (BPL) through the public distribution system (PDS) in India. This program is aimed to be one of the largest to provide food for around 2/3 of the India's populations, which is under BPL category.

This paper is an attempt to study the need and improvement, which can be brought by introduction of new technological innovations in various disciplines including agricultural practices and distribution systems to ensure food security in Indian context. Further, the paper reviews the use of technological advancements such as Information technology (IT), nanotechnology, biotechnology etc. to achieve food security. The improvements can be brought not only in food production but also an effective distribution can help us in reducing losses by innovative use of technology. The advantages and disadvantages of technology and their intake by the producers, distributors and consumers were examined in Indian context.

2 Literature review

A literature review was carried out to understand the usage of different technology types in various sphere including agriculture/food production and distribution. Salin (1998) suggested the importance of IT in agricultural industry and supply chain strategy to control food quality, safety and weather-related supply variability. An appropriate usage of IT systems in agri-supply chain helps in generating information and ensuring the availability at appropriate level. He suggested that the IT system should shift controls of

food supply chain from retailer to farmers. This provides opportunity to farmers to be leaders in the supply chain and work towards improving performance of the entire chain, i.e., from farm-to-retail. Mittal (2008) described role of IT in providing timely and quality information for decision making to Indian Agriculture Industry and in-turn help to improve the efficiency and productivity. This timely information helps extension workers in providing better services to farming community. He suggested the importance of e-powering rural India, changing pattern of information requirements, introduction of state of art technologies such as remote sensing, geographical information system (GIS), bio-engineering etc. This can be achieved by usage of satellite technologies, remote sensing and GIS application which help in efficient planning, advising and monitoring the status of the crops and quick response to disaster, soil problem and crop stress. Fiona (2000) proposed the model of IT application in USA which resulted in improvement of production to achieve single farmer feeding 128 individuals. This is achieved by providing information to farmers by global positioning system, internet and satellite to utilise their land more effectively, optimise water, energy and chemical inputs and successfully market their products.

Another important aspect of food security is to apply technology to understand the changing requirements of climatic conditions. There is the intrinsic link between the food security and climate change, population growth and the need to sustainably manage the world's rapidly growing demand for energy and water (Beddington, 2010). He suggested that a combination of technology from different discipline such as biotechnology and engineering with advancements of nanotechnology, will be required to ensure food security. The constant supply of economically reasonable priced food requires adaptation of multiple technologies (Garnett et al., 2013). The adaptation study of four eastern European countries, China, Mongolia, South Korea, and Japan, which have huge variation in terms of population size, food preference and agricultural practices, was conducted by Mosnier et al. (2014). The study indicates the heterogeneous impact on these regions and need of flexible trading system to create balance on domestic and import and help to reduce negative impacts.

Andersen and Cohen (1999) identified natural resources management, agricultural development as two important constrains to food security apart from other constraints. It was proposed that public investment in agricultural research is crucial. Research projects must be focused on the exploitation of appropriate technology to achieve sustainable agriculture production, environment factors and also density of population. Modern biotechnology used in conjunction with traditional or conventional agricultural methods, has the potential to help agricultural productivity in developing countries. Bindraban and Rabbinge (2011) had suggested the role of Europe to achieve food security for the Asian countries. The strategies include biotechnology application based on local conditions. There is a need for redistribution of resources across the globe to achieve sustainable growth. Kasturi (2009) described importance of development and technology transfer initiatives to increase the agriculture production around the world which resulted in Green Revolution. The green revolution initiatives include developing high yielding varieties and disease resistant grains, improved irrigation facilities, modernised infrastructure and use of fertiliser and pesticides. He suggested the need for exploiting new technology like biotechnology, IT and nanotechnology. Buttriss and Riley (2013) had suggested that food security and food sustainability needs to be pursued together. Manning (2008) focused on the issues of surrounding water security in term of quantity and quality and its impact on food availability. Warad and Dutta (2005) suggested the

importance of nanotechnology which requires interdisciplinary research in physics, chemistry, engineering and biology. An understanding of changes at nano level in relation to microscopic properties and molecular structure of biological materials related to plants and animals will lead to new revolution in production. The UNPD Human Development Report (2001) stressed the unique potential of genetic engineering (GE) techniques for creating virus-resistant, drought–tolerant and nutrient-enhanced crops. This report suggested a need for public investment into research and development in biotechnology to meet the agricultural needs of the world's poor. Norman and Hongda (2003) emphasised potential of application of nanotechnology in improving the efficiency of crop production, food processing and food safety, environmental impact on crop production and food products and increase storage and distribution capabilities. Ejeta (2009) focused on a new era of research requirements to achieve global food security which needs to further ensure food security at local level. Involvement of government to fund development of agricultural universities is required. Cribb (2011) identified the challenges to achieve feed the population by 2060 including the large investment in agricultural sciences and technological developments. He has also emphasised to develop a food security system which is energy efficient and focused on reduction of loss.

Escaler et al. (2010) proposed the Rubanisation concept where rural and urban should be viewed as single space. The key components of Ruban concept are self-contained zones surrounded by farms and crop plantation, a system for managing energy, and utilisation of renewable technology. The sustainable economies can be developed by appropriate linkages using IT and transportation system.

3 Current and future technologies advancements in agriculture production and its distribution

The biggest challenge for the world is to feed the current increasing population which in turn means it must ensure 40% increase in food production in a limited land and water using less energy, fertilisers and pesticide by 2030. The exploitation of existing technologies and new scientific discoveries in technology will lead to such arrangements. Accordingly, multi-stranded approach is needed at national level to achieve food security through enhanced good agricultural policies and its implementation along with an efficient agricultural supply chain. The focus should be to reduce the distribution losses through improved technology. The review of the domains where technological advancement is essential to ensure food security along with need for further improvement is presented below.

3.1 Biotechnology

Biotechnology is a systematic science which utilises the benefits of micro-organisms or components produced by micro-organisms, in agricultural or industrial process. There are evidences from history for usage of micro-organisms in food preparation preservation and transformation of raw agricultural commodities into edible products for human consumption. Biotechnology is a combination of diverse technologies that can be applied in different food and agriculture sectors. It includes technologies such as gene modification (manipulation) and transfer to achieve desired characteristics in plants, development of recombinant vaccines and DNA-based methods of disease

characterisation/diagnosis. Biotechnology can be utilised in reproductive techniques like in-vitro vegetative propagation, embryo transfer etc for increased production. The science and art of biotechnology can be utilised in plant and animal origin food products to achieve higher yields. This area requires relatively more focused research to achieve the goal of food security in developing countries. There are cases of development of transgenic plants with commercially useful traits such as resistance to herbicides, insects and viruses. In the year 1990s transgenic plants were approved by regulatory agencies in the USA for commercial use after evaluation and testing, thereafter, the commercial production of transgenic plants as genetically modified (GM) crops started in the USA. The research must ensure the food safety and lethality aspect for usage of such bioengineered crops. The bioengineered crops require less usage of pesticide and in turn result in reduce cost to farmer, crop protection and benefit both environment and public health. GE helps to achieve better productivity by providing grains with increased yields and reduced inputs costs, which is required to feed a growing global population, introduce resistance to pests and disease without high cost purchased inputs, increased crop's tolerance to adverse weather and soil conditions, improve the nutritional aspects of some foods and enhance the durability of products during harvesting or shipping. The application of molecular biology-based science to agriculture has been focused mainly on large farm in developed countries

An area of concern in exploitation of biological science in agriculture is with regard to Intellectual Property Rights (IPRs) and the allocation of benefits between developed and developing countries' farmers and Agribusiness Corporation that provide the GM seeds. However, there are questions and concerns regarding health impacts especially related to the role of allergens in crop biotechnology. An alternative approach with enhanced policy initiatives all around the world for better investments in agricultural biotechnological research is required. Further, there are instances of opposition to GM food in some countries like European Union and India, resulting in serve setback to the research in agricultural sector. Also, it may be important to understand the implications due to over use of such technologies and their hazardous impact, if any to living organism. There should be motivation for private sector to develop technologies for poor people by offering to buy exclusive right to newly developed technology and make it available either for free or for a nominal charge to small farmers. A more comprehensive public and private sector involvement can lead to research. This can be achieved by converting some social advantages to the private gains.

3.2 Nanotechnology

Nanotechnology is a new subset of science, dealing with nanoparticles which are of the tenth magnitude. Nanotechnology is not yet widely exploited to achieve food security. However, it is progressing rapidly by usage of interdisciplinary research. Nanotechnology is the science which helps scientist to understand the structure at molecular level and relate the same to microscopic level. This technology has the potential to improve the efficiency of crop production, improve food processing and food safety, minimise environmental impact of crop production and food products and increase storage and distribution capabilities (Norman and Chen, 2003). Nanotechnology can be applied in agricultural food system for reproductive methods for conversion of agricultural and food wastes to energy and other useful by-products using enzymatic nano-bioprocessing, disease prevention and health protection of plants and animals (Norman and Chen 2003).

The combination of nanotechnology with available technology like genomic and micro-electronics can be utilised in development diagnostic kits to detect and monitor the spread of plant and animal diseases. Nanotechnology can be utilised in the area of packaging and storage to increase the shelf life. However, it is equally important to establish the safety aspect while exploiting any of these technologies .Some of the plastic wraps can be developed to prevent food from spoiling by inhibiting the growth of bacteria and even edible coating can be developed using nanotechnology application (Kasturi, 2009).

3.3 Information technology

IT can be utilised as a strategic tool for agricultural development and welfare especially in rural India. The potential of IT can be explored for direct contribution to agricultural productivity by empowering farmers to take relevant information and timely quality decision which will have positive impact on the agriculture and allied activities. Precision farming extensively uses IT to make direct contribution to agricultural productivity. Other techniques such as remote sensing using satellite technologies, GIS and agronomy, soil science help to increase the agricultural output. These techniques provide useful information where large scale agriculture production is practiced .With the advent of corporate in agricultural retail sector these technologies are explored to the benefits of retailers. Agricultural production in India is primarily at small scale farms owned by small farmers generally less than 1 acre. Mobile enable information sharing will be useful for India as it provides timely and reliable sources of information for decisions making to individual farm owners. At present, the farmer depends on trickling down of decision inputs from conventional sources which are slow and unreliable. The changing environment faced by Indians farmers makes information not only useful, but necessary to remain competitive. Consideration must be given to generating investment in IT and communications in the developing countries including India and parts of African countries so farmers can gain benefits of communication and technology.

3.4 Metreological advancement

The biggest threat to food security comes from the current imbalances caused by the climate change. With every 1ºC increase in temperature, there is an estimated decrease in crop production by 5%. Technology, including computers, advanced radars and the weather satellites, are keys to collecting data needed for weather forecasting for decision making. The correct weather forecasting helps the farmers to sow the seeds and harvest the plants at right time and locations.

4 PDS in India

The technological advancement in distribution system in India can be understood by PDS in India. PDS in India was created in 1939, an effort to reach the urban as well as the rural population and protect consumers from fluctuating grain prices. PDS system is an important component to achieve food security in India which is established under Ministry of Consumer Affairs and Public Distribution jointly managed by State Governments. The distribution system in a big country like India is a big challenge with different geographical conditions within a state as well. Also, food grains are subjected to

pilferage, black marketing and Government has to fight corruption. The prime objective of the PDS in India is to ensure food security and poverty alleviation by making available the essential commodities, especially for food grains at an affordable and uniform price at the door steps of the consumers. In earlier days the system was almost completely manual and used a network of 4.7 lakh 'fair price shop' and provided grain to millions of Indians population. The computerisation of the entire supply chain of PDS in India can be an effective mean to manage these challenges and provide effective food grain and asset management.

4.1 Food corporation of India

Food Corporation of India (FCI) was established in 1965 under the Food Corporation Act 1964, since its inception FCI has played a significant role in India's success in transforming the crisis management oriented food security into a stable security system. The grain procurement trend is being explained below.

Table 1 The procurement pattern

Marketing year	*Wheat**	*Rice**	*Coarse grains**	*Total**
2005-06	147.85	276.56	11.54	435.95
2006-07	92.26	251.07	0.002	343.332
2007-08	111.27	284.91	2.03	398.21
2008-09	226.82	336.83	13.75	577.40
2009-10	253.82	236.87	3.20	493.89
2012-13	381.48	317.44	0.72	699.64
2013-14	250.92	261.38	10.94	523.24

Note: *Unit: Lakh MT

Source: Annual report 2009–2010, 2013–2014 of Food and Public distribution system

Following are the key objectives of FCI:

- effective price support operations for safeguarding the interests of the farmers
- distribution of food grains throughout the country for PDS
- maintain satisfactory level of operational and buffer stocks of food grains to ensure national food security
- to implement the National food security Act 2013
- to strengthen the PDS and improve public service systems.

Department of Food and Public Distribution was set up with its prime goal to ensure food security for the country through timely and efficient procurement and distribution of food grains. The food insecurity is not always a result of lack of food, however, in several countries it is because of lack of availability of the food at required destination. The poor distribution system is an important cause for food crisis at national level. As per FCI, there is significant damage of food grains Department of Food and Public Distribution is exploiting technology advancements to take preventive measures through system improvements and use of IT of fighting corruption in all areas of work. The use of IT

enabled system for e-payments to vendors, suppliers etc., publishing complete details of tenders on websites, e-procurement, reverse auction and providing information and status of applications to citizen/public etc. The solution is aimed at providing three key functions to the FCI. A transaction data system would enable the FCI to share information between depots and district level officers. Information compiled using the Management Information Software would form the second function of the solution. The third function was forecasting supply and demand. The solution is an intranet-based web interface, allows all other related departments to work on same database. The data and reports are generated periodically without any delay. There is an interlinking of modules information sharing for improved coordination. Government of India has implemented a new policy 'National Policy on Handling, Storage and Transportation of Food Grains' in June 2000 to minimise storage and transit loses. This policy provides provision for creation of integrated bulk handling, storage and transportation facilities to the tune of 5.5 lakh MTs at identified locations in producing and consuming areas by involving private sector participation through 'Build-Own-Operate'. FCI moves around 250 lakh tons food grains over an average distance of 1500 kilometres. An average of 12,000,000 bags (50 kilogram) of food grains are transported every day from the producing states to the consuming areas, by rail, road, inland waterways etc. This can be achieved by effective planning and management of the transport system. The preservation of food grain starts, the minute it arrives in the godowns. The bags are transported on wooden crates/poly pallets to avoid contact with moisture from the floor. The stocks are fumigated to prevent infestation at a frequency of around 15 days with Malathion and once in three months with deltamathrinetc. Curative treatment is done with aluminium phosphide on traces of infestation. The quality of the food grains are impacted, if the technology is not appropriately utilised.

Gaya PDS is an excellent example of effective PDS in India by providing an integrated platform for central, state and districts interaction. Also, all warehouses are computerised including the weighing bay to avoid any corruption. The food grain movement is monitored on real time basis with the help of GPS services. The procurements, storage and distribution system is made transparent, accountable and well managed. This PDS system is directly under the administrative control of District Magistrate and managed through District Supply Officer. The movement of food grains is also available on real time basis.

4.2 Food security bill in India

The National Food Security Bill (Right to Food Act) was made law on September 12, 2013 in India. The Act provides right to every citizen of the country eligible under the scheme to get grains at the subsidised prices through a target PDS in India. The Government of India allocates rice, wheat, sugar and kerosene oil to various states Government which in-turn sub-allocates the same commodities to the districts. The allocations are based on the density of population at each location. Some of states like Tamil Nadu, Madhya Pradesh and Odisha have their own security program. This bill is likely to have a cascading inflation effect on common person as the estimated annual expenditure of 1,247,470 million Indian National Rupees approximately (Press Information Bureau, 2013). A SWOT analysis was carried to understand the Food Security Act, 2013 which is placed in Table 2.

Table 2 SWOT analysis

Strengths	*Weakness*
• To provide basic food grains at subsidised price to the poor • To guarantee minimum support to farmers	• The sufficient funds are not being planned in the budget 2013 to cover the 2/3rd of poor population • Weak policy with regard to implementation of the same at ground level • The implementations are left to state which may vary across India. • The procurement, transportation storage and distribution from fair price shops are not defined • Lack of infrastructure may lead to leakage and spoilage during storage and transportation. • Adequate quantity and availability of food grains with public authorities • Weak agricultural practices to ensure sufficient quantity and quality of the produce
Opportunity	*Threats*
• Reform of current Public Distribution System both at central level and at the state level • Use of technological advancements in agricultural practices to meet the requirements of food grains in the countries • Exploring new science of biotechnology and nanotechnology to develop improved crop varieties and production. • Use of Information and Communications Technology in distribution and supply chain. • Effective communication system is required to create awareness about the scientific principle, available policies etc. • Appropriate information sharing mechanism with regard to agricultural practice, geographical and climatic conditions for sustainable production • Dynamic Policy initiatives to integrate different ministries involved in Ministry of Agricultural, Ministry of Environment and forest, ministry of Consumer Affairs, Ministry of Railways and various state authorities. • Reaching out to people for equal participation to achieve Food Security in India	• Huge size of population widely distributed across the country • It is a challenge to identify right target consumer as the distribution is both in rural and urban area • Enforcing the implementation without prior risk assessment • Non-availability of appropriate tools to deliver the desired production and distribution at all levels • Wastage of food grins due to lack of access to correct, clear and complete information • Lack of coordination between various Ministries and decision makers • Loop hole is the existing system and flow of Inappropriate use of the scheme by non-needy person

5 Discussion

Food security covers all aspects from production to supply till it reaches the consumer. The application of technology is needed at all stages for which innovation would be required to feed the ever increasing world population. A key issue of this millennium is to feed a future population right quality, healthy and safe food at all time with limited natural resources. Agricultural development and supply is critical to achieve food security. Hence, the initiatives worldwide need to be focused on application of latest technology in agricultural production and distribution. Accelerated public investment to facilitate agricultural and rural growth is recommended through development at following levels:

- high yielding crop varieties, which can tolerate adverse climatic conditions
- crop and livestock which are resistant to pest and diseases
- new improved environmentally friendly production techniques by exploiting the technology
- initiatives to develop an effective distribution network and minimise losses
- develop more reliable support system to provide timely and reasonably priced access to information considering all elements of food chain
- improved extension service and technical assistance programs for better information sharing
- investment in agricultural research to achieve food security
- technology transfer from research to practicing world including farmers.

New modern technology application in conjunction with traditional or conventional research methods will provide quick and easy solution to fight against hunger and poverty in developing countries. These technologies should be made available to poor farmers and distribution. Biotechnology, nanotechnology, GE helps in achieving better production combined with IT enabled agri-supply chain to improve PDS in India. In view of the current trends, policy initiatives should drive towards development of mobile enabled agricultural information centre. Mobile application is easily available to all farmers and can easily provide quick and reasonably priced information.

There is a need to explore the range of science and technology opportunities and related challenges imposed by such technologies. An effective national bio safety regulation should be in place to ensure consumer safety prior to introduction of modern biotechnology in a country. The vital contribution from science will require a systematic and focused research driven by more lucrative policy initiatives across the world. An effective Food and PDS in India will lead to food security. In the agri-supply chain food producers should be drivers not retailers and timely information sharing among partners. The lack of technology in supply chain can lead to high storage and transit losses. The use of IT enabled tracking system during transit, biotechnological application in storage to avoid pest infestation etc. can assure the food grains as produced reach consumers.

Another, important element to achieve food security is to educate the next generation about the importance of food and natural resources and to prevent their wasteful usage.

6 Conclusions

This paper was an attempt to study the various technologies which can be utilised to achieve food security in India by developing robust agriculture production, practices and distribution system in India. There is a need to divert more resources towards high quality research and development of existing and emerging technologies to the developing world. The important areas identified from the study where technological research needs to be focused include:

- crop improvement by development of new and better quality of seeds and agriculture extension facility
- usage of water and fertilisers which are low cost and environment-friendly
- crop protection and effective management to avoid resistance problems by use of biodegradable ways
- sustainable livestock farming and aquaculture with improved veterinary drugs usage practices
- reduction of post- harvest losses at storage and distribution.
- coordinated information sharing among the various stakeholder of the food chain
- effective strategies to communicate risk and reduce the gaps created by delayed access to information.

It has been noticed in the study that plenty of good research is being carried out in biotechnological area and IT, however the same is not available at the point of use. One of the ways to achieve effective information update is through mobile application. It is recommended that more user-friendly ways to implement these researches may be explored in future research.

India has enforced the Food Security Act 2013 as a step towards achieving the MDG. However, there are constraints due to poor understanding of the policies and principle and issues in the monitoring system, combined with several operational inefficiencies in implementation with limited infrastructure to effectively provide the Food for all citizens of India.

The solution lies in effective exploitation of cost effective, environment friendly development and usage of technology.

It is identified that there is concern on outputs of modern agricultural biotechnology in India resulting in restrictions. There is a need to create awareness among the various stakeholders including farmers, policy makers, regulators and consumers. Further studies can be done to identify role of various stakeholders in the global scenario as well as in Indian context. Currently the biosafety aspects including genetic engineered seeds are under Ministry of Environment and Forest in India. The suitable coordination among various other Ministries such as Ministry of Agriculture, Ministry of Health and Family Welfare, Ministry of Consumer Affairs, Ministry of Commerce and Industry etc. as should also be ensured in policy making. Regulation for IPRs, GM Products etc should be in place at the time of dispute settlement. The policy should be available to regulate the research activities and implementation of this research to the farm level. It is also

suggested that international organisations like WHO and Food and Agriculture bodies should participate in development of standards.

The other area of concern is the PDS in India where frequent losses are observed at storage and distribution. An improved distribution system with modern infrastructural requirement for storage and transportation and IT enabled communication system in agri-supply chain would help to achieve food security. In India, Chhattisgarh has implemented the computerised procurement of paddy successfully. The IT system should be further applied to track the storage and distribution of the grain. There is a need to further explore the gaps in communication network of PDS in India .There is a need for further research on location, quantity and quality conditions of the warehouse. However while exploiting technological solutions the accessibility and economic feasibility may be considered.

A reinvention of the global food security system is recommended. The research and development activities should be shared globally in order to avoid drainage of resources in reinventing the same technology. This paper recommends that involvement of Public Private Partnership in research, production practices and supply can provide solutions to the increasing concern on food security globally. New policies and incentives should be available for investment in this sector.

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