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The Future of Food and Agriculture in India: Trends and Challenges

Vishwambhar Prasad Sati
Senior Professor, Department of Geography and Resource Management, Mizoram University, Aizawl – 796004.
Email: sati.vp@gmail.com

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ABSTRACT

Indian economy is mainly agriculture based where about 70% people is dependent on practicing it. It positions second and shares about 11.3% of the cultivable land within the world. That is why India has a high possibility to control agricultural resources for current and upcoming food security. Yet, about 21.9% (2016) of population are living under the poverty line and likewise, a large number of individuals are deprived or uncertain about food. This situation is most critical in rural areas. This study shows the present status, future trends, and challenges of food and agriculture sector in India. Time series data of the past thirty years was collected from secondary sources on area, production, and yield of crops; irrigated area; production of major crops; area, manufacture, and yield of crops in the major food-manufacturing states of India; food storage and poverty. Regression analysis, correlation techniques, and descriptive statistical methods were used to analyse the data. The potential for food production in the major food-producing area was measured by indexing state-level data on the acreage, output, harvest of yields and irrigated land into levels. It was noted that the advanced growth rate of food manufacture is higher than the total people, which means that food is sufficient to feed the people however, it is not available to all optimally, because of food wastage, packaging leakage, lack of food preservation, and proper circulation of food. If food is stored preserved and distributed in well manner, there would not be at all food deficiency in India, the study exposed.

1. INTRODUCTION

Worldwide agricultural production has improved at an average rate of 2% a year between 1961 and 2007 (GHI 2008) and thus, it is estimated that the world presently produces sufficient nourishment to feed everyone. However, at least one billion people remain food insecure (FAO 2010). FAO (2017) projected that about 800 million people are frequently starving and two billion people suffer from micronutrient deficiencies. About 700 million people living in rural areas are still tremendously deprived today. Only seven nations account for two thirds of the world's malnourished people: Bangladesh, China, Congo, Ethiopia, India, Pakistan, and Indonesia. According to FAO (2010). Low availability of sufficient food is a problem that affects both developed and developing nations, as evidenced by the fact that around 15% of Americans live in food-insecure families (Jensen 2011).

The majority of the common people in emerging nations exist in rural regions and rely heavily on agriculture for their economy. Substantial growth in agriculture is effective in reducing poverty, making agricultural investment especially pro-poor (World Bank 2007) of the world's 1.1 billion really underprivileged population, about 810 M (74 %) live in borderline areas and rely on small-scale farming. Despite industrial progress, more over 70% of Indians still exist in rural areas (2011), where more than 60% of the workforce is employed in agriculture, up from 70% in the early 1990s. This figure stands for 44% (2002) in

China and 21 % in Brazil (2004).

The global population will most likely rise to over nine billion by 2050 (UNPD 2008) however, most of the population growth will happen in low-income countries (UNPD 2006). The urban population, which is now 50%, is projected to rise to 66% by 2050 (UNPD 2007). To meet the requirement of the growing population both in urban and rural areas, food manufacture would have to rise by almost 70% in the period 2000-2050 (UN 2009), which is 1.1% annually (Bruinsma 2009; Alexandratos 2006; World Bank 2007; OECD 2010; Tilman et al. 2011). Land loss, deforestation, and increased competition for natural resources are all results of this growth in food production. (FAO 2017). Future food demand will also be impacted by the intricate economic and social forces exhibited by population expansion. On the other side, between 1960 to 1990, crop yields significantly increased. Beginning in the 1990s, the yield rate started to slow down, going from roughly 2.9% in 1966 to 1.3% in 2006. (Cassman 2010). Both wealthy and emerging nations have seen a decline. However, due to significant public sector investment, yield growth has risen in Brazil and China (Lobell 2009). Due to a number of technological limitations, agricultural yields in Africa and Asia are lower than in other nations (Godfray 2010).

Though, global crop yields grew by 115% between 1967 and 2007 yet, the area of land in agriculture improved only by 8%, which stands for approximately 4,600 million ha. The unprecedented increase in world crop production was primarily due to an increase in yields; expansion of land under cultivation and irrigation was another driver (FAO 2006). High population pressure on cropland (Pimentel and Pimentel 2003) and climate change (Nelson et al. 2009) will further affect crop production and yield.

India's current economy is typically based on agriculture. As of 2011, about 70% of the world's population is dependent on ancient traditional agricultural practices. Rain-dependent agriculture accounts for 79.44 million ha (57%) of the total estimated 140.3 million hector net cultivated area (Anon 2009), or 44% of the total food grain production. Overall, relatively less new land has been carried into agriculture in current decades. During the 'Green Revolution' effort in the late 1960s, high-yielding seed varieties were incorporated together with increasing use of water supply and improved fertilizers. These led to the development of agricultural productivity and a rapid extension of agricultural acreage. This has been proved by the fact that in 1951, per capita food availability was 418 kg/year, which increased to 471 kg/ha in 2007, which is a 12.7% increase (Planning Commission of India 2008).

In terms of high production and productivity of crops, mostly wheat and pulses, Panjab, Haryana, and Uttar Pradesh were the states that were most significantly impacted by high-yield variety (HYV) crops and the Green Revolution, however a rise in production was seen in nearly all of India.

Similarly, a report from the Ministry of Agriculture, Government of India (2014) states that per capita food availability in 2009 was 444 grams/day, which increased to 510 grams/day in 2013. Despite the rise in the amount of food available per person, about 20% of Indian children under five are malnourished. (UNICEF 2014). Similarly, many poor people are deprived or insecure about food and thus, about 21.9% (2016) of people live under the deficiency line. Mismanagement of food products such as wastage and leakages, lacking food storage, and improper public distribution system (PDS) were observed as the major drivers of food shortage in India. Further, the production and yield of crops are not uniform in the Indian states, which has also led to sectoral disparities in food security.

This article examines the present and future trends in food production mainly food grains, fruits, and vegetables in India. Further, it aims to increase the understanding of the nature of the challenges that food and farming systems are facing today and will face in the future. It studies trends of the area, production, and yield of crops and projects future challenges and potentials. To ensure that the food production units and agricultural sectors reach their full possibility and that everyone in India has a healthy future, significant changes in typical farming systems, rural economies, and natural resource management will be needed. Irrigation plays a significant role in increasing crop production and yield.

Study Area

India, also known as the Indian sub-continent, is one of the important countries of the Asia continent and is an emerging economy among the developing countries of the world. Ranks second in the world population and seventh in area, India lies in the Northern Hemisphere, which characterizes both tropical and subtropical climates. It stretches between $8^{o}4'$-$37^{o}6'$ latitudes and $68^{o}7'$-$97^{o}25'$ longitudes and occupies a 3,287,263 km^2 area. The total net area sown is 46.64%, of which 43% is irrigated. The Ganges basin is the biggest alluvium plain in the world, which supports the livelihoods of about 50% of India's population. Forest covers only about 21.34% area. Owing to high diversity in both physical and cultural aspects, it is called a land of unity in diversity. Diversity in agro ecological conditions and

landscapes enhances suitability in growing various crop races/cultivars. The states, which lie in the Ganges plain – Bihar, Uttar Pradesh, and West Bengal, including Punjab and Haryana obtain high cultivation and yield of crops. High soil fertility and adequate water supply facilities are the major drivers of developed agriculture in these states. Many states in India are hilly and some of them are highly prone to drought, where agriculture is rain-fed and fully dependent on Monsoon rain, production and harvest of crops is consequently less.

2. METHODOLOGY

This study was directed using exploratory and quantitative analysis approaches. A large data was gathered on the area, production, and yield of agricultural and horticultural crops from the Directorate of Economics and Statistics of Agriculture and Corporation, New Delhi from 1991 to 2014. Data on national-level irrigated areas, food stocks, and people living below the poverty line was also gathered during the period. Gathered data were averaged on a five-year basis and then changes were noticed in the zone, manufacture, and yield of crops. Production of the main crops during the three-five years plan (10^{th}, $11^{th,}$ and 12^{th}) was analyzed and changes in production were observed. A regression model was employed to correlate irrigation intensity with production and yield and a hypothesis was formulated to test the relationship between them. Correlation among irrigation, food production, and yield was carried out. Descriptive statistics were also applied to find out the mean value and std. deviation of area, production, and yield of major crops (2013-14). Area, production, the yield of crops, and irrigated area (2013-14) in the major food-growing states of India were also analyzed. Data were indexed and levels of states were noted in terms of production, area, and yield of crops and irrigated area.

The position of India in the world's agriculture was discovered. To predict the forthcoming of food grain and agriculture sector in India, an assessment of the population's growth rate (1951–2011) and the pace of progressive growth in food production was made.

Major trends of food and agriculture in India

Area, production, and yield of food grains and irrigation intensity

A five-year average was used to acquire and analyse data on the area, production, and yield of seed grains as well as the intensity of irrigation from 1990–1991 to 2013–2014. (**Fig. 1**). The amount of land planted with food grains declined by 1.4% throughout the course of the study period, from 127.84 million hectares in 1990–1991 to 126.04 million ha in 2013–2014. Production has since grown by 50.1%, from 176.39 million tonnes to 264.8 million tonnes. The yield of crops has also increased, going from 1,380 kg/ha in 1990–1991 to 2,101 kg/ha in 2013–2014, an increase of 52.2%. On the other hand, the intensity of irrigation has also grown during the time by 41.9%.

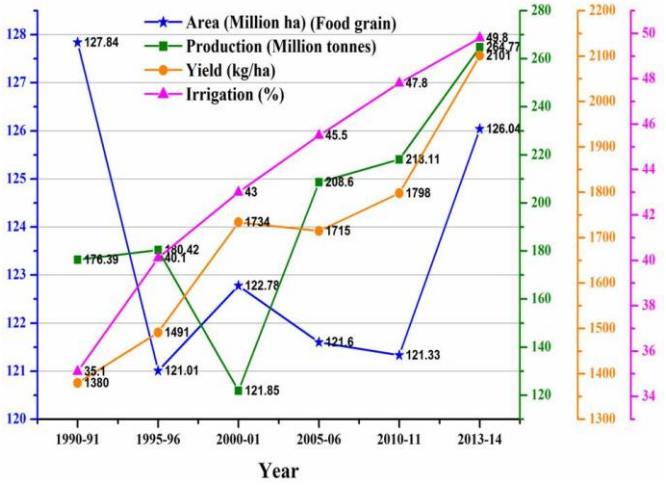

Figure 1: Area, production, and yield of food grain and irrigation intensity

Source: Directorate of Economics and Statistics of Agriculture and Cooperation

Area, production, and yield of horticulture and plantation crops

Data on area, production, and yield of horticulture and plantation crops from 1990-91 to 2013-14 were also analyzed (**Fig. 2**). The area of horticulture and plantation crops has increased by 114.9% from 0.94 million ha in 1990-91 to 2.02 million ha in 2013-14. Similarly, the production of these crops increased from 15.21 million of tonnes to 44.31 million of tonnes (191.3%) during the period. In terms of yields of horticulture and plantation crops, it was 16,254 kg/ha in 1990-91 and 21,967 kg/ha in 2013-14 with an increase of 35.1%.

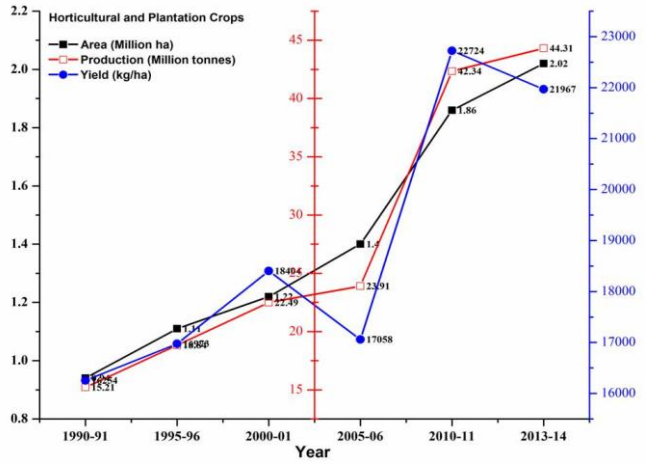

Figure 2: Area, production, and yield of horticulture and plantation crops

Source: Directorate of Economics and Statistics of Agriculture and Cooperation

Production patterns and changes in major crops

Although India grows many crop races/cultivars yet, we selected the major crops, which have high production and yield value and which are the staple food. Data on the production of major crops during the three five-year plans, i..e. 10th, 11th, and 12th from 2002-03 to 2015-16 (**Table 1**) was analyzed. Five-year production data of each plan period was analyzed and then changes were observed. The highest production was of sugarcane crops in all five-year plans, which was followed by rice, wheat, coarse cereal, oilseeds, cotton, pulses, and jute. Production of crops has increased from 5.5% of Jute to 128.8% of cotton. Pulses have obtained a 44% increase in production, oilseeds 41.2%, wheat 36.4%, coarse cereal 30.6%, sugarcane 25.4%, and rice 24.3%.

Table1: Production pattern of major crops and changes (million tonnes)

Crop	10th five-year plan*	11th five-year plan*	12th five-year plan**	Change in production (%)
Sugarcane	279.0	325.8	350.0	+25.4
Rice	85.7	97.2	106.5	+24.3
Wheat	70.3	84.4	95.9	+36.4
Coarse cereal	33.0	40.0	43.1	+30.6
Oilseeds	23.3	29.0	32.9	+41.2
Cotton#	16.0	28.1	36.6	+128.8
Pulses	13.4	15.9	19.3	+44.0
Jute and Mesta@	11.0	11.1	11.6	+5.5

Source: Directorate of Economics and Statistics of Agriculture and Cooperation
million bales of 170 kg each
@million bales of 180 kg each
*Average of five years (2002-03 to 2007-08); (2008-09 to 2013-14)
**Average of two years (2014-15 to 2015-16)

Levels of area, production, yield of food grains, and irrigation intensity

Area (million hactor), manufacture (million tonnes), and harvest (kg/ha) of food crops was analyzed and irrigation intensity (%) was observed in the main food grain-producing states of India (**Table 2**). State-wise area under food crops was indexed as <5 to above >15 and levels of the area – low to very high – were observed. Seven states of India, Uttarakhand, Jharkhand, Assam, Tamil Nadu, Gujarat, Haryana, and Chhattisgarh cover <5 million ha area, which is low; medium level area (5-10 million ha) is obtained by six states – West Bengal, Odisha, Punjab, Bihar, Karnataka, and Andhra Pradesh. Three states – Maharashtra, Rajasthan, and Madhya Pradesh possess a high level of zone (10-15 million ha) under food grains. There is only one state i.e. Uttar Pradesh which has >15 million ha area (very high).

Crop production was indexed from <10 million tonnes (low) to >30 million tonnes (very high). Seven states such as Uttarakhand, Jharkhand, Assam, Chhattisgarh, Gujarat, Odisha, and Tamil Nadu obtain low production (<10) of food crops. It is followed by six states (medium production) – Karnataka, Bihar, Maharashtra, Haryana, West Bengal, and Rajasthan (10-20). High-crop producing (20-30) states are Andhra Pradesh, Madhya Pradesh, and Punjab. However, Uttar Pradesh state produces very high food grains (>30).

The harvest of crops is very high in Haryana and Punjab (3,000 kg/ha), which is followed by five states – Uttarakhand, Tamil Nadu, Uttar Pradesh, Andhra Pradesh, and West Bengal - 2,000-3,000 kg/ha (high). Maharashtra, Rajasthan, Chhattisgarh, Odisha, Karnataka, Madhya Pradesh, Jharkhand, Gujarat, and Bihar (nine states) obtain medium level (1,000-2,000 kg/ha) in terms of yield of crops.

Irrigation plays a important role in the high production of crops and agricultural intensification. We indexed irrigation intensity (%) from below 25 (low) to 25-50 (medium), within 50-75 (high), and above 75 (very high). Three states – Assam, Jharkhand, and Maharashtra have less than 25% irrigation intensity. Irrigation intensity from 25-50% is obtained by seven states; four states obtain 50-75% irrigation. Uttar Pradesh, Haryana, and Punjab have >75% irrigation intensity.

Table 2: Levels of crop area, production and yield, and irrigation intensity in India; 2013-14

Indices	**Level**	**States**
Area (Million ha)		
< 5	Low	Uttarakhand, Jharkhand, Assam, Tamil Nadu, Gujarat, Haryana and Chhattisgarh
5-10	Medium	Odisha, West Bengal, Punjab, Bihar, Karnataka, and Andhra Pradesh
10-15	High	Maharashtra, Rajasthan, and Madhya Pradesh
>15	Very high	Uttar Pradesh
Production (Million tonnes)		
< 10	Low	Uttarakhand, Jharkhand, Assam, Chhattisgarh, Gujarat, Odisha, and Tamil Nadu
10-20	Medium	Karnataka, Bihar, Maharashtra, Haryana, West Bengal, and Rajasthan
20-30	High	Andhra Pradesh, Madhya Pradesh, and Punjab
>30	Very high	Uttar Pradesh
Yield (Kg/ha)		
< 1000	Low	Nil
1000-2000	Medium	Maharashtra, Rajasthan, Chhattisgarh, Odisha, Karnataka, Madhya Pradesh, Jharkhand, Gujarat, and Bihar
2000-3000	High	Uttarakhand, Tamil Nadu, Uttar Pradesh, West Bengal , and Andhra Pradesh
>3000	Very high	Punjab, Haryana
Irrigation intensity (%)		
< 25	Low	Assam, Jharkhand, and Maharashtra
25-50	Medium	Rajasthan, Karnataka, Odisha, Chhattisgarh, Uttarakhand, Gujarat, and West Bengal
50-75	High	Madhya Pradesh, Andhra Pradesh, Tamil Nadu, and Bihar
>75	Very high	Uttar Pradesh, Haryana, and Punjab

Source: Data collected from the Directorate of Economics and Statistics of Agriculture and Cooperation and analyzed by the author

Descriptive statistics of area, production, yield, and irrigation of food crops in 17 major food-manufacturing states among India were carried out (**Table 3**).

The mean state area ranges from 7.2 million ha (the lowest) to 20 million ha (the maximum); the mean production ranges from 1.8 million tonnes (the minimum) to 50.1 million tonnes (the maximum); and the mean yield of crops ranges from 1,198 kg/ha (the minimum) to 4,409 kg/ha (the maximum). With a mean value of 46.4%, irrigation also fluctuates from a minimum of 4.6% to a maximum of 98.7%.

Table3: Descriptive statistics of area, production, yield, and irrigation (n=17 states)

Variables	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Variance**
Area (million/ha)	1	20	7.2	5.1	25.9
Production (million tonnes)	1.8	50.1	15.2	11.6	134
Yield (kg/ha)	1198	4409	2186	855	731283
Irrigation (%)	4.6	98.7	46.4	27.3	744

Note: Status of the year 2013-14

Correlation among irrigation, cultivation, and harvest of crops was observed (**Table 4**). We found 0.013 significant values between irrigation and production and irrigation and yield. Similarly, a significant value was also high between production and yield (0.133

Table 4: Correlation among irrigation, production, and yield (n=17)

Variables		Irrigation	Production	Yield
Irrigation	Pearson Correlation	1	0.588*	0.804**
	significant. (2-tailed)		0.013	0.000
Production	Pearson Correlation	0.588*	1	0.380
	significant (2-tailed)	0.013		0.133
Yield	Pearson Correlation	0.804**	0.380	1
	significant (2-tailed)	0.000	0.133	

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

A linear regression model was employed to analyze the correlation among irrigation, total production, and harvest of crops (Figures 3 and 4) and it was observed that irrigation has a significant implication on crop manufacture and yield. We hypothesized that the higher the irrigation intensity, the higher the manufacture and harvest of crops. In Punjab and Haryana, where irrigation intensity is above 90%, production and yield of crops were the highest in these states although, arable land in both states share only 5.2% and 3.5% respectively of the national average.

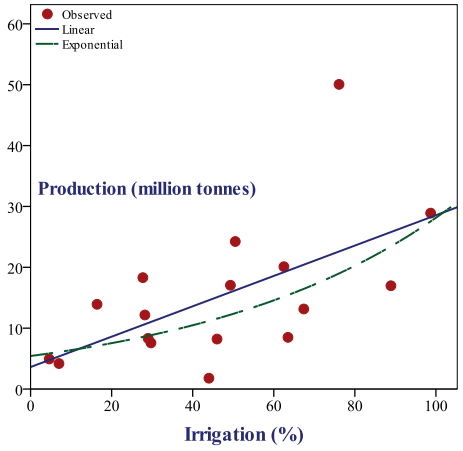

Figure 3: A linear regression analysis showing a correlation between irrigation and production

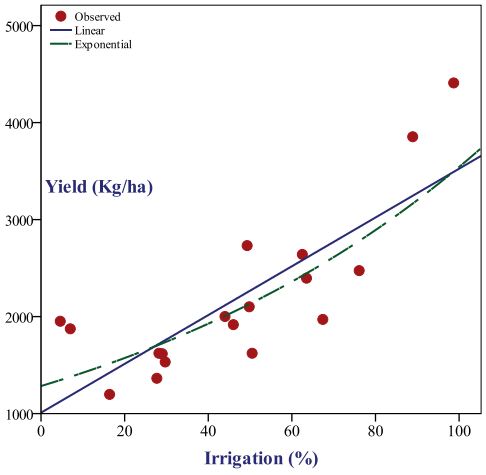

Figure 4: A linear regression analysis showing a correlation between irrigation and the yield of crops

Food stock status and changes

Data on food stock status shows about a 125.4% increase during the period 1990- 2014 (**Table 5**). The increase was 52.6% in rice stock, 199% in wheat stock, and 216.7% in coarse cereals although, food stock capacity, as a whole, decreased substantially during the period 2005-06 and 2013-14.

Table 5: Food grains stock in the central board (million tonnes)

Year	Rice	Wheat	Coarse cereals	Total
1990-91	9.63	9.38	0.12	19.13
1995-96	17.42	12.88	-	30.30
2000-01	14.18	17.17	-	31.35
2005-06	12.76	8.93	-	21.70
2010-11	24.35	23.09	0.25	47.69
2013-14	14.70	28.05	0.38	43.12
2018-19	17.1	29.41	0.51	47.02
Change (%)	52.6	199	216.7	125.4

Source: Department of food and public distribution

India's situation in world farming

Table 6 shows India's position in world agriculture in 2012. We compared a total of 20 variables. Although it ranks seventh in total land area, it has vast arable land accounting for 11.3% of the world share and ranks second after China. Out of the total 20 variables, it ranks first in the production of pulses (25.5% world's share), rearing buffaloes (57.3%), and milk production (16.9% world's share). Except in the production of rapeseed and tea (third rank), it ranks second in all other crops such as paddy, wheat, vegetables, fruits, and cotton.

Table 6: India's situation in world cultivation

Variable	% share	India's rank
Land area	2.3	Seventh
Arable land	11	First
Population	19	Second
Agriculture	25.2	Second
Wheat	12.3	Second
Paddy	21.7	Second
Pulses	25.8	First
Groundnut	16.62	Second
Rapeseed	10	Third
Vegetables	10.1	Second
Fruits	12.5	Second
Potatoes	11.6	Second
Onion (dry)	22,1	Second
Sugarcane	19	Second
Tea	20.6	Third
Cotton	32.5	Second
Cattle	12.5	Second
Buffaloes	56.5	First
Goats	13.1	Second
Milk	20.42	First

Source: FAO Statistics, 2016

The progressive growth rate of food production and population

Production of crops and population data of the last 60 years (1951-2011) was analyzed and the progressive growth rate of both was observed (**Fig. 5**). From 1951 to 2011, food production increased by 381.1% whereas the population increased by 235.2%. It shows that food production has increased higher (about 62%) than the population. We also projected production and population growth rate in India between 2011 and 2021 based on the past averages of growth rate. The decadal projected growth rate between the periods was noted as 17.6% in crop production and 15.3% in the population.

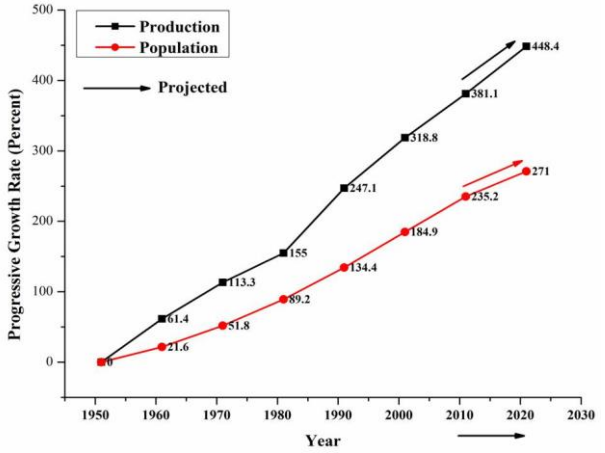

Figure 5: Progressive growth rate in food production and population

Poverty status

The people living beneath the poverty line in India was analyzed (**Table 7**). Data on rural, urban, and total poverty between 2004 and 2012 were gathered from the Perspective Planning Division, Planning Commission of India. Rural poverty was observed at higher (25.7%) than urban poverty (13.7%) whereas total poverty was noted at 21.9% (2012). A decrease of 34.8% in rural poverty and 46.3% in urban poverty was noticed during the period 2004-2012. As a whole, 41.1% of poverty has decreased in India between 2004 and 2012.

Table 7: Population existing under the poverty line (Tendulkar Methodology) (%)

Year	Rural	Urban	Total
2004	42	25.5	37.2
2010	33.8	20.9	29.8
2012	25.7	13.7	21.9
Change 2004-12 (%)	-38.8	-46.3	-41.1

Source: Perspective Planning Division, Planning Commission

Major challenges of food and agriculture in India

The above description of food and agriculture in India shows increasing trends in the production and yield of crops. It has vast arable land and many people practice farming. Further, diversity and suitability in agro ecological conditions enhance potentiality in the field of agriculture. Indian people grow large food grains, fruits, and vegetables. In the meantime, it undergoes several challenges, which impede the prospects of food and agriculture. We have described them in the following paragraphs.

Lacking irrigation facility

India's agriculture is heavily dependent on monsoon as about 57% of agriculture is rain-fed. Irrigation facilities are inadequate and mainly limited in the major river basin. Although water resources are plenty yet, they are not properly used and equally distributed. Inadequacy in irrigation in drought-prone states of India manifests distress among farmers, and thus, yields of crops remain below average. Meanwhile, draught-prone states of India are among the leading states having a high potential for Micro Irrigation.

Food subsidy issue

Food subsidy has been a major issue of food security and nutrition among the marginal farmers and people who live below the poverty line. A study reports that about 66.5% of the outlay for food subsidy was spent on procuring food grain from farmers, maintaining stocks, and paying carrying costs, and interest whereas, only 31.2% of the money was spent on subsidizing food grains. Leakage and theft of food grains are other issues that impede food subsidy and as a result, 13 paise (cents) per rupee spent on food subsidy reaches the poor (Down to Earth 2010).

Improper public distribution system

In India, Public Distribution System (PDS) is the oldest (1939) and the biggest food security apparatus in the world. 81% of rural and 67% of urban households in India according to the Planning Commission of India (2010) have ration cards. In India, 10.5% of households in urban areas and 26% of households in rural regions have BPL cards. However, ration cards are not present in 28% of rural households in Andhra Pradesh, 29% in Chhattisgarh, 23.2% in Jharkhand, and 33% in Odisha, all of which have sizable tribal populations. PDS in India was unable to live up to its promise and failed to reach its intended audience. Its goal is to provide food for the underprivileged, however despite this, it has completely failed and is a

multi-billion rupee swindle (Aiyar 2005). More than 90% of the population in Uttar Pradesh, Bihar, Odisha, and Madhya Pradesh, according to the Planning Commission of India (1994), does not purchase any cereals from PDS. Additionally, during the past few years, the prices of food commodities in PDS have climbed significantly relative to market pricing, and as a result, many individuals are moving to the open market. Additionally, this has led to a reduction in PDS from one million tonnes to 60,000 tonnes annually (FCI 2014).

Lacking food storage and wastage of food

Technological developments in the agricultural section have led to a steady increase in grain production, but poor storage and preservation practices cause significant losses in food grain. A third of India's impoverished may be fed with after-harvest losses in India, which equal to about 12 to 16 million metric tonnes of food annually, according to the World Bank Report (1999). These losses have a monetary worth of above fifty thousands crores yearly (Singh 2010). The Government of India procured 63 million tonnes of food grains for PDS of which 28 million tonnes of food grain are stored in the open space, which has resulted in a loss of Rs. 60,000 crores (FCI 2015)

Wastage of food due to the shortage in storage caused food damage. A study shows that about 1.06 lakh tonnes of wheat were damaged in Punjab and Haryana in the year 2012. This also caused the bad quality of grain. According to Godfray et al. (2010), 30% - 40% of all food produced is discarded, which causes losses for farmers and creates pressure on natural resources. The total food storage capacity in India is 336.04 lakh tonnes, including hired space, whereas, food production in the year 2011-12 was 667.89 lakh tonnes. Additionally, due to an absent of proper care and skilled staff, 3.12 lakh tonnes of storage capacity was lying without proper utilization. A large amount of rupees is spent on hiring storage (Voice of Youth 2012).

Lacking cold storage

India grows large-scale fruits and vegetables and it ranks second in production in the world. Seasonal obtainability of these crops is so high and often they are unexploited. Farmers struggle to obtain the input cost of their crops. The situation is grim all over India. Due to a shortage of cold storage, fruits and other commodities in the Himalayan states go mostly unharvested during the growing season. Additionally, it results in low pricing, which prevents farmers from getting their true returns.

Discussion and Conclusions

This study has presented the trends and difficulties of food and agriculture and revealed that India has vast fertile arable land, ample water, and diverse agroecological conditions for growing various crop races/cultivars. In addition, crop cultivation are significantly higher than population growth. The availability of water and arable land are distributed unevenly, which affects crop output and yield, which varies from state to state. It also demonstrates that current crop production and yield trends are sufficient to support India's expanding population; yet, because of poor PDS, insufficient storage space, and poor management, the food supply is insufficient and many people are still existing under the poverty line. Agriculture and food futures largely depend on India's ability to mitigate its current problems and manage its food supply. It has been noted that while output and yield have significantly increased, the area planted with food grains remains essentially unchanged. Horticulture and plantation crops have expanded in area, production, and yield and are growing faster than food grains despite having a far smaller fraction of the total area under cultivation. It implies that there is also a strong potential for cultivating horticulture and plantation crops. Although their share of total production is reduced, cotton, pulses, and oilseed production have increased significantly during the course of the three five-year plans (10th plan to 12th plan). These crops require care and can expand in areas with favourable agro-climatic conditions. Other crop production saw a significant increase.

Analysis of state-wise data on the yield of crops revealed that in the states where irrigation facilities are high to very high, crop yield is simultaneously higher. These states are Haryana, Punjab, Uttar Pradesh, Andhra Pradesh, West Bengal and Tamil Nadu. Furthermore, the yield of crops is comparatively less in the states where irrigation facilities are inadequate. It means that irrigation has a significant impact on crop production and yield, as we observed 0.013 significant values. The prospect of manufacture and harvest of crops is substantially dependent on the adequacy and availability of irrigation facilities, the study revealed.

India has high potential and suitable agro-climate to grow a large quantity of crop races/cultivars – vegetables, fruits, paddy, and wheat. It obtains huge arable land, as it shares 11.3% of arable land and ranks second in the world. Further, it has significant potential to produce pulses and milk and milk-made products. All these drivers may enhance future growth in food and agriculture. Apart from it, there has been noticed an increase in food grain stock (rice, wheat, and coarse cereals) during the last decades. This increase occurred mainly because of huge production

growth. In the meantime, food storages are not adequate mainly during the crop season, crop products are kept open and as a consequence, a huge amount of food is destroyed.

Unlike the Malthusian model (1798)[1] of population growth and production of crops, which says the population grows exponentially while food production rises arithmetically; this study revealed that advanced progress rate of productivity is higher than the inhabitants and or growth rate in India. That is why food production in India is enough to feed every person.

Despite high growth in cultivation and yield of crops, people living in BPL are still higher in comparison to other countries. Further, food grain allocation to people is not adequate and thus, a number of people are deprived to meet the required 2400 calories per day (One World 2014). A study carried out by the Centre for Science and Environment (CSE) shows that 58% of the subsidized food does not reach the BPL families, 36% of food is sold in the black market and the fair shops are not viable, prone to food leakage (Down to Earth 2007). There has been noticed a continuous decrease in poverty in India in the last few decades and this can be further reduced if food is distributed equally and properly. However, if the present situation continues in the future, India will have to double its food production by 2040 (The Indian Express 2012). The Government of India has framed and implemented several schemes for attaining food security besides PDS. Some of them are MNREGA, Antodaya, and PMRY, which have enhanced rural livelihood and food security.

Agricultural strategies through the introduction of new seed varieties, technology, innovative practices, and crop diversity are inevitable to meet the future demand for food (Niggol 2010). This is also important to resilience to the climate variability and change, which India is facing. Participation of farmers and communities in agribusiness and market management will lead to better use of natural resources and wellbeing of people. A large portion of people of agricultural land should be dedicated to cultivating horticulture and plantation crops and to attain food security. Further, proper planning and implementation of micro irrigation can increase the manufacture and harvest of crops in drought-prone areas of the country. Our study revealed that food production in India is enough to feed everyone. Meanwhile, food scarcity is caused mainly because of the wastage of large amounts of food, improper distribution, and lack of storage. To attain food security and better management of agricultural products, many food storages are required to be constructed. PDS system should be made effective and smooth and for that FCI can play a greater role, if it is made prompt and responsible. Construction of adequate cold storage in fruit and vegetable growing areas, access to the market, and the role of government in providing food management are the major and important drivers for future nutrition and farming prospects in India.

[1] Principle of population, modified in 1803

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