



Indian Cereals Saga: Standpoint and Way Forward

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ABSTRACT

Cereals are synonyms with Indian food production, obviously due to its lions share (~90%) in total Indian food basket. Since time immemorial, fate of Indian agriculture heavily depended upon the success of cereals production. Agricultural glory of India must be strengthened all the way through achieving self sufficiency in food production first; secondly, by improving our agricultural image in global arena, by getting rid of being a net importer to net exporter, through strong presence in global agriculture market. We are marching through in the right direction; cereals are the leaders in the food commodity export especially rice "The Basmati Rice". Since, as of now, Indian share in the world trade is meagre (~1.0%), there is a need to scale up to the tune of 6% in very quick succession. No doubt, Cereals and coarse cereals should be front leaders in this endeavour. Since a lot more has to be done to improve cereal productivity, we have to do more on policy aspects. This article discusses at length on past glory, present status and future prospects of the great Indian food basket famously known as "The Cereals".

Keywords: Agriculture, coarse cereals, food grains, rice, wheat, India economy

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INTRODUCTION

Agriculture, in India, is a way of life, its mother culture of all culture. Owing to this, agriculture never becomes business, until recent past (Mittal, 2008 and Singh et al., 2013). Agriculture in India is still a backbone of its National economy and will remain at least for a decade or two, is largest employer of its mammoth human resources (Government of India, 2006; NITI Aayog, 2015). India is home of 16.8% of world's population harbouring only on 4.2% of world's water resources and 2.3% of global land. This is staggering 4 to 6 times low per caput availability of resources as compared to world average (OECD and FAO 2012; FAOSTAT, 2010). With \$9.59 trillion, India is now world 3rd largest economy in terms of purchasing power ability (IMF, 2016). This economic solidarity is due to praiseworthy consistent 7% GDP growth achieved during last two decades (World Bank and IMF, 2012) with same tempo of long-term perspective. India is now considered and classified as newly industrialised Nation being a part of the G-20 major economies (Forbes, 2016). Chinese GDP, which was 6.7% in 2016, is looming large with further downwards projection in near future (Zhang, 2016). Global GDP growth in 2016 is estimated to perform at 2.3% and is projected to rise to 2.7% in 2017 (World Bank, 2017).

India Agricultural Background

India is the second largest and first producer of rice, wheat and millets, the world's most important energy driving staples food (Prakash, 2011; AOSTAT, 2013). Stakeholder of Indian GDP are agriculture, industry and services and the share of agriculture sector in the Indian DGP was at its best at the independence, was fallen to 45% during 1954-55 (Arjun,

2013), gradually due to fast all round development in other sector, contributes of agriculture declined, though the contribution of agri-sector is still remain significantly 14% to the overall GDP and still provides employment to the 49% of Indian workforce (Anonymous, 2015 and Ministry of Finance, 2010).

To feed a country with over 1.25 billion population and growing, there is always pressure to produce more food especially cereals (Alexandratos and Bruinsma 2012; DES, 2000; Nature, 2010). It was felt mandatory to achieve agricultural growth rate of 4% to make India not only self sufficient food production, but also to become net exporter from net importer (Mittal, 2008; Patnaik, 2010). Growth in agricultural output is characterized by fluctuations, the annual growth rates of approximately 3% in the 10th Plan, 4% in the 11th Plan and just 1.7% during the first three years of the 12th Plan. This poor performance is due to cereals crop segments, which are subject to occasional severe negative shocks leading to serious distress (NITI Aayog, 2015). Indian agriculture growth is ranged bound barring few exceptional years.

This year (2016-17) India may surpass the above said target of 4% with impressive estimated forecast of food production (ICAR, 1998). As a result of very good rainfall during monsoon 2016 and various policy initiatives taken by the Government, the country has witnessed record food grain production in the current year. As per second advance estimates for 2016-17, total food grain production in the country is estimated at 271.98 million tonnes (Table 1), which is higher by 6.94 million tonnes than the previous record production of Food grain of 265.04 million tonnes achieved during 2013-14 (DAC, 2017).

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Table 1: Estimated food grain production during 2016-17

Food Items	Production (MT)
Rice	108.86
Wheat	96.64
Coarse cereals	44.34
Pulses	22.14
Total	271.98

Source: DAC, 2017

Availability of cereals to Indians: miles to cover

Indian food preference has dramatically changed over the period of time since it got independence during 1947.

Table 2: Per capita net availability (g/day) of cereals pulses and total food grains in India 1951-2014

YEAR	RICE	WHEAT	OTHER CEREALS	CEREALS	PULSES	TOTAL
1951	158.9	65.7	109.6	334.2	60.7	394.9
1961	201.1	79.1	119.5	399.7	69.0	468.7
1971	192.6	103.6	121.4	417.6	51.2	468.8
1981	197.8	129.6	89.9	417.3	37.5	454.8
1991	221.7	166.8	80.0	468.5	41.6	510.1
2001	190.5	135.8	56.2	386.2	30.0	416.2
2010	184.8	167.9	54.3	407.0	31.6	438.6
2014	177.2	173.6	51.3	444.1	47.2	491.3

Source: Economic Survey (2016)

Table 3: Gross cropped area across under major crops in India during 2001-02 and 2013-14.

Crop Group	Period	
	2001-02	2013-14
Rice	24.0	22.4
Wheat	14.2	15.6
Coarse Cereals	15.9	13.1
Total Cereals	54.0	50.9
Total Pulses	11.3	12.5
Total Food Grains	65.3	63.6
Sugarcane	2.3	2.6
Condiment and Spices	1.3	1.6
Total Fruits	2.1	3.6
Total Vegetables	3.3	4.7
Total Oilseeds	12.4	13.9
Total Fibres	5.2	6.6
Tobacco	0.2	0.2
Other Crops	7.8	4.2
GCA	100	100

Source: DAC, 2016

Consumption of rice has been increased up to 1991 and started decline since 2001. Consumption of wheat has been registered increasing trend except during 2001 (Economic Survey, 2016). However consumption of other cereals has registered declined trend over the period of time. Pulses consumption is fluctuating solely due availability, India is still considered as vegetarian population (Singh et al., 2013). Total food grains net availability (g/day) per capita in India has been improved significantly from 394.9g to 491.3g with highest 510.1g during 1991 (Table 2). However according to the Organization for Economic Co-operation and Development (OECD, 2015), supply and consumption of cereals pulses and edible oils is not upto the mark and are even lower than South Africa, Brazil and Indonesia. Indian National average is 2455 kcal per day.

Data depicted in Table 3 revealed the distribution pattern of gross cropped area for major crop commodity or groups has not much change. However it is worth to mention that gross crop area under cereals consisting of rice wheat and coarse, which was 3% less as compare to what it was holding during 2001-2002. Major chunk of this (3% gross cropped area) was shifted towards pulses and oilseeds. This is clear-cut indication of Indian agriculture is moving gradually from food secure nation to nutritional secure country. For nutritional security only cereals can happily left their share for other crop with increasing production and productivity in vertical way (NITI Aayog, 2015).

Historical prospective vis-a-vis Five year plan and performance:

In all the five year plan (FYPs), the overall target of food grain production was achieved the milestone and it might be due to the consistent effort, which was taken by the Ministry of Agriculture and Farmers Welfare, GOI in this direction, which fulfils the requirement of food for ever increasing population (Table 4). In case of rice, which is major food grain crops, in IXth FYP the target which was assigned to produce the 437 MT, it was achieved during the mentioned periods. The similar growth pattern was followed in case of XIth FYP (97.5) except Xth FYP, where the target were achieved only ~93.2%. But in case of wheat, the reverse trends were followed during in all the FYP. During the IXth FYP, the attainable target was achieved 96.3 MT later onwards reduced drastically up to 81.7% in XIth FYP. The positive sign was recorded in target and achievement of coarse cereals production in the country under the changing climate scenarios. During all the FYPs from IXth to XIth, the consistent increment was recorded, which is clearly means the scope for crop diversification and sustainability in agriculture for farming community.

The commodity based comparison indicated that West Bengal produced the maximum rice production (14.34 MT) followed by Punjab (11.24 MT) and Uttar Pradesh (10.81 MT) among all the major rice growing states in the country (Table 5). However, the maximum share in rice production were recorded in West Bengal (16.11%) followed by Punjab (12.62%) and Uttar Pradesh (12.14%) during the 2009-2010, respectively. In case of wheat, Uttar Pradesh was recorded to

Table 4: Target and Achievement of Production of Major Crops during 9th 10th and 11th Five Year (Million Tonnes)

Crop	IX th Plan (1997-98 to 2001-02)			X th Plan (2002-03 to 2006-07)			XI th Plan (2007-08-2011-12)		
	Target	Achievement	(%) Target Achieved	Target	Achievement	(%) Target Achieved	Target	Achievement	(%) Target Achieved
Rice	437	436.6	99.9	460.1	428.6	93.2	479	467.4	97.5
Wheat	370	356.5	96.3	386.6	351.7	91.0	399	325.9	81.7
Coarse Cereals	169	156.5	92.6	176.8	165.1	93.4	199	186.9	93.9
Food Grains	1052	1015.3	96.5	1100.1	1012.	92.0	1064	1048.8	98.5

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation

produce the maximum production (27.52 MT) followed by Punjab (15.17 MT) and Haryana (10.5 MT). This might be due to the improved agricultural practices, high yielding photo-insensitive varieties along with more acreage under these crops, which helps to achieve the target during 2009-2010. The maximum shared contribution in wheat production was recorded by Uttar Pradesh (34.2%) followed by Punjab (18.77%) and Haryana (13%), respectively among the wheat growing states. In case of maize, Karnataka was contributed the maximum in terms of production and their shared in maize production (3.01 MT and 17.94%) among the major maize growing state in the country. With respect to the coarse

cereals production, the central (Maharashtra) and southern parts (Karnataka) of the country had been contributed significantly in terms of both contribution and their shared in total coarse cereals production during the year of 2009-10. Among the states, Uttar Pradesh was recorded to contribute the maximum production (43.2 MT) and shared (19.8%) followed by Punjab (26.95MT and 12.35%) and Madhya Pradesh (16.02 MT and 9.33%). This might be due to the better management practices coupled with moderate weather condition, which helps to achieve these magic milestones (DAC, 2016).

Table 5: Three Largest producing states of important crops during 2009-10

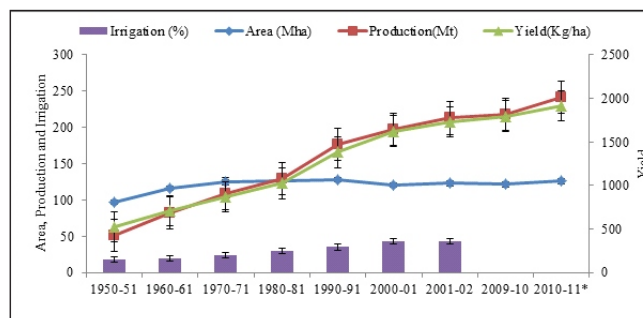
Rice	Mt	% Share	Wheat	Mt	% Share	Maize	Mt	% Share	Coarse Cereals	Mt	% Share	Total Food grains	Mt	% Share
West Bengal	14.34	16.11	Uttar Pradesh	27.52	34.20	Karnataka	3.01	17.94	Maharashtra	6.29	18.75	Uttar Pradesh	43.20	19.80
Punjab	11.24	12.62	Punjab	15.17	18.77	Andhra Pradesh	2.76	16.50	Karnataka	5.90	17.58	Punjab	26.95	12.35
Uttar Pradesh	10.81	12.14	Haryana	10.50	13.00	Maharashtra	1.83	10.94	Rajasthan	3.91	11.65	Madhya Pradesh	16.02	9.33
All - India	89.09	-	All-India	80.80		All - India	16.72		All - India	33.55		All - India	218.11	

The progressive increment in area, production, and productivity as well as irrigation facility was recorded since 1950-51 to 2010-11 (Fig. 1). The data revealed that increment in area by 1.3 fold, production by 4.78 fold, productivity by 3.68 fold, irrigation by 2.37 fold, respectively since last six decades. It shows a linear growth in overall of these attributes, which helps in phenomenal jump in production and productivity of the food grain. This sustainable growth was due to adoption of modern agricultural practices, scientific intervention and the better market policy made by the Ministry of Agriculture and Farmers Welfares, GOI during the last six decades. But attention is now required to accelerate the vertical diversification, as on now horizontal expansion of agricultural land is limited due to much pressure population on the land. Therefore, GOI needs to revise the policy and action plan for better growth rate of agriculture in future.

Seasonality in Indian cereals production

The data clearly showed that since the last six decades, the total decadal trend in areas was remains constant and ranged from 115.3 Mha (1966-67) to 125.73 ha during 2010-11, which shows that the further increase in growth total acreage is not

possible due to various reasons (Table 6). The season wise trend clearly indicated that in kharif season, where the acreage for growing the crop ranged from 78.21 Mha in 1966-67 and 72.12 Mha in 2010-11. However, the maximum expansion in kharif acreage (83.21 Mha) was recorded 1980-81. Similarly in rabi season, the significant increase in area for crop cultivation was recorded since the last six decades. The overall 1.44 fold increase in acreage was recorded during the rabi. This might be due to better irrigation facility and

**Fig. 1:** All-India decadal trend in area, production and yield of food grains, along with coverage under Irrigation

adoption of short duration crops varieties especially in oilseeds and pulses. The phenomenal jump was recorded during both the season since 1966-67 to 2010-11 in terms production and productivity. The data revealed that 2.45 fold in production and 2.66 fold of productivity increment was noted between 1966-67 to 2010-11 during the kharif season.

Table 6: Season-wise decadal trend in area, production and yield of food grains

Year	Kharif			Rabi			Total		
	A	P	Y	A	P	Y	A	P	Y
1966 -67	78.21	48.89	625	37.09	25.34	683	115.30	74.23	644
1970 -71	82.36	68.92	837	41.96	39.50	941	124.32	108.42	872
1980 -81	83.21	77.65	933	43.46	51.94	1195	126.67	129.59	1023
1990 -91	80.78	99.44	1231	47.06	76.95	1635	127.84	176.39	1380
2000 -01	75.22	102.09	1357	45.83	94.73	2067	121.05	196.81	1626
2010 -11*	72.12	120.20	1667	53.61	121.36	2264	125.73	241.56	1921

A - Area (Mha), P - Production (Mt), Y - Yield (Kg/ha)

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

Rice: The King of Indian food basket

Rice is the staple food crop (Singh *et al.*, 2015a), grown in an area of 44 Mha with a production of 108.68 Mt, during 2016-17 (DAC, 2017). The country witnessed an impressive growth in rice production in the post-independence era due to adoption of semi dwarf high yielding varieties coupled with the adoption of intensive input based management practices. In order to keep pace with growing population, the estimated rice requirement by 2025 is about 130 Mt. The current situation necessitates looking for some innovative technologies to boost rice production (Singh *et al.*, 2015b).

The decadal trend in area, production and productivity of rice along with coverage under the irrigation were recorded to significant increase growth since the last six decades (Fig. 2). In case of acreage of rice, 41.6% of horizontal expansion was recorded between 1950-51 to 2010-2011. But in case of production and productivity, a tremendous increment was observed since the last six decades. The production and productivity of rice were increased by 4.63 fold and 3.35 fold, respectively from 1950-51 to 2010-2011. Similarly irrigation facility, the significant improvement was recorded during the last six decades. The data showed that the 1.7 fold improvement in irrigation acreage was recorded since 1950-51 to till 2010-11. It clearly indicates that the progressive growth is taking place in this direction, which is directly responsible

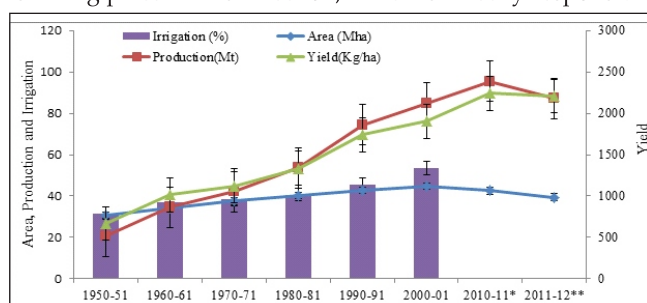


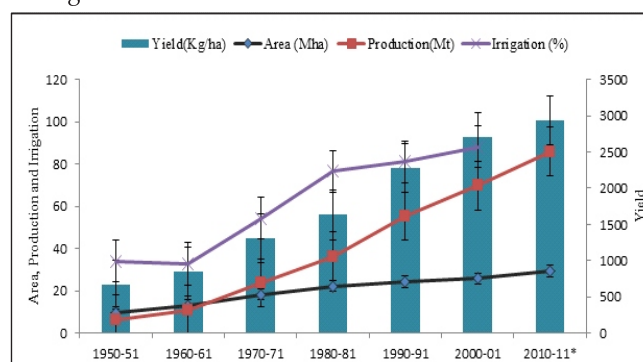
Fig 2: All-India decadal trend in area, production and yield of rice along with coverage under Irrigation

Similarly, in rabi season significantly higher increment in production by 4.78 fold and productivity by 3.31 fold of food grain crops. This might be possible due to better crop management coupled with better weather condition, which helps to achieve these milestones.

for enhancing the input use efficiency and overall improvement in production and productivity of the kharif crops.

Wheat: The Rock star emerged

Wheat is the most staple and second most important food crop after rice in the country, which contributes nearly one-third of the total food grains production (Kumari and Singh, 2016). Wheat contains more protein than other cereal and has a relatively high content of niacin and thiamine. In case of wheat, decadal trend in area, production and productivity along with coverage under irrigation were recorded to improve significantly since the last six decades (Fig 3). About 3 fold increment in growing of wheat area was recorded during 1950-51 to 2010-2011. But in case of production and productivity, a remarkable increment was noted since the last six decades. The production and productivity of wheat were increased by 13.3 fold and 4.43 fold, respectively from 1950-51 to 2010-2011. Similarly, significant improvement in irrigational facility was also recorded since last six decades. The data showed that 1.7 fold improvements in irrigation acreage were noted since 1950-51 to 2010-11.



* Fourth Advance Estimates as released on 19.07.2011.

Fig 3: All-India decadal trend in area, production and yield of Wheat along with coverage under Irrigation

Maize : The Marvels performer

Maize, is one of handful crop which are grown in all seasons in India, used in variety of purposes right from as cheap sources of energy to high demanding industry (Paramkusam and Sivaramane, 2015). The all India decadal growth rate of acreage, production and productivity of maize crop showed a rapid growth rate over the years (Fig.4). The area under this was increased by 2.3 fold; production by 12.3 fold and productivity by 4.58 fold has increased over the six decades from 195-51 to 2010-11. This might be possible due to a consequence of the development of high yielding improved varieties and hybrids and acreage increase under the rabi maize production and industrial sector, which helps to achieve this phenomenal jump especially in this crop among the cereals groups. In case of irrigation facility, here also growth rate of area brining under the irrigation command in maize had been increased almost doubled (22.4 Mha) in 2000-2001 since 1950-51(11.4 Mha).

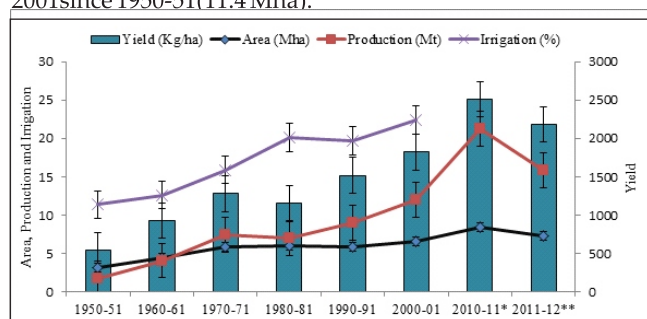


Fig.4: All-India decadal trend in Area, Production and Yield of Maize along with coverage under Irrigation

* Fourth Advance Estimates as released on 19.07.2011

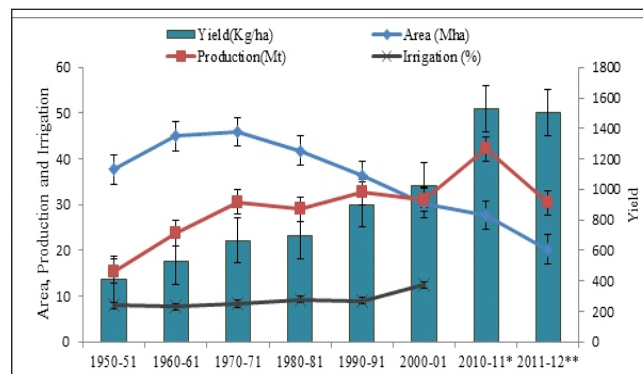
** First Advance Estimates released on 14.09.2011.

Note: The yield rates given above have been worked out on the basis of production and area figures taken in '000 units.

Coarse Cereals: The barometer of Indian agriculture

In our country, the coarse cereals are mainly grown in poor agroclimatic regions, particularly rainfed areas of the country. These crops are grown in areas with high temperature and are called dryland crops because can be grown in areas with 50-100 cm rainfall. These crops are less sensitive to soil deficiencies and can be grown in inferior alluvial or loamy soil. Currently, India holds 4th position in the world in coarse cereal production after USA, China and Brazil but the amount produced is only 3.6% of the global coarse cereal production. As per 2014 figures, Karnataka, Rajasthan and Maharashtra are the top coarse cereal producer states of India. (<http://www.gktoday.in/blog/cultivation-and-consumption-of-coarse-cereals-in-india/>)

Similarly, the decadal trend in area, production and productivity along with coverage under irrigation in coarse cereals showed that comparative variation since the last six decades (Fig 5). The cultivating areas of coarse cereals was declined drastically by 1.86 fold from 1950-51 to 2010-11 but the reverse trends were followed in case of production and productivity. It was noted that the production and productivity of coarse cereals crops were increased by 1.97 fold and 3.68 fold, respectively during the period of 1950-51 to 2010-2011. However, significant improvement of 1.7 fold in irrigation acreage were recorded during the mentioned periods.

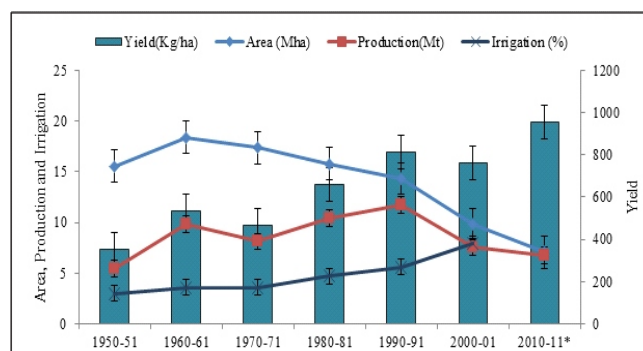


* Fourth Advance Estimates as released on 19.07.2011.

Fig 5: All-India decadal trend in area, production and yield of Coarse Cereals along with coverage under Irrigation

Jowar: Needs Push

Sorghum is the major staple food of millions of rural poor in arid and semi-arid regions of the world. It is the second cheapest source of energy and micronutrients after pearl millet and majority of population in the central India depend on sorghum for their dietary and energy requirements (Rao *et al.*, 2006). Because of its drought adaptation capability, sorghum is a preferred crop in tropical, warmer and semi-arid regions of the world with high temperature and water stress conditions. In case of jowar, also decadal trend in area, production and productivity and irrigation facility showed remarkable variation over the last six decades (Fig.6). The cultivating area of jowar was declined by 2.20 fold from 1950-51 to 2010-11, but the production and productivity trends remains improved consistently by over the years. It was interestingly noted that production of jowar was more than doubled (11.68 MT) during the 1990-91 from the 14.36 Mha. Similarly the productivity was also improved by 2.71 fold over the last decades. It might be possible due to the farming community given equally importance about adoption of improved agricultural practices and use of HYVs. In case of irrigation facility, the acreage under irrigation was brought by 2.63 fold during the last six decades. This might be possible due to the proper attentions were given by the farmers especially input like irrigation, without it is not possible to miracle increase in production and productivity of these crops too.



* Fourth Advance Estimates as released on 19.07.2011.

** First Advance Estimates released on 14.09.2011.

Fig. 6: All-India decadal trend in area, production and yield of jowar along with coverage under Irrigation.

Bajra: The Marvels performer

In developing countries, pearl millet is recognized as an important crop which helps with food shortages and meeting the nutritional demands of an increasing population. It constitutes an important source of dietary calories and protein in the daily diet of a large segment of the poor population. Although pearl millet is consumed as a major staple food, the nutrient availability to the human gut is constrained by certain inherent antinutritional factors (*Polyphenols and phytic acid*).

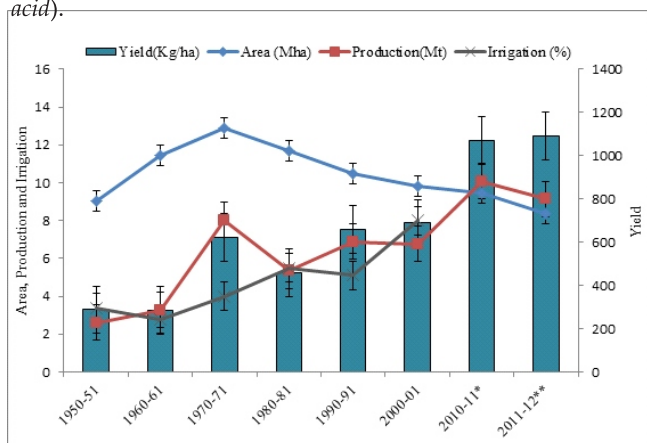


Fig 7: All-India decadal trend in area, production and yield of Bajra along with coverage under irrigation

* Fourth Advance Estimates as released on 19.07.2011

**First Advance Estimates released on 14.09.2011

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

The similar trend in area, production and productivity and irrigation facility showed notable disparity in Bajra over the last six decades (Fig. 7). The cultivatable area of this crop was remained constant 9.02 to 9.43 Mha during the period of 1950-51 to 2010-11, but the production and productivity trends improved tremendously by over last 50 years. Here, also it was interestingly notable that acreage under its cultivation were consistently increased up to 1970-71 and further the declining in area expansion was noted up to 2011-12 even in increasing the production and productivity almost 3-4 times. In case of irrigation facility, acreage was increased by 2.35 fold during the last six decades. This may be due to the proper attentions were given by the farmers to achieve this milestones.

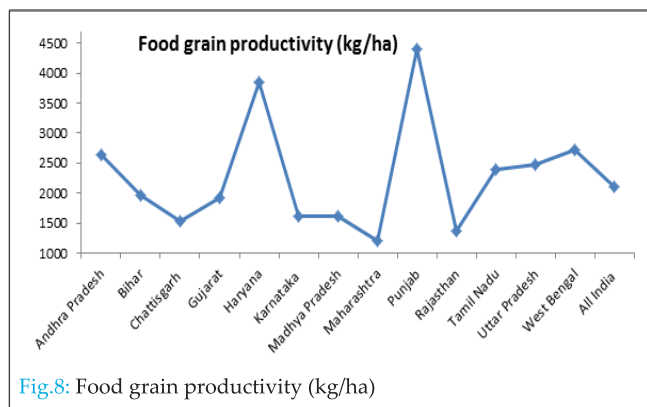


Fig.8: Food grain productivity (kg/ha)

2. Creation and extension of irrigation infrastructure via rivers linkage

Performance of Indian agriculture is still lies in the successful and timely onset of monsoon as well as it duration after 70 years of Independent India. Hence, here in India, agriculture without assured water supply will never be profitable enterprising. This is million dollar question? Because, India's biggest challenge in agriculture sector is water scarcity and its efficient management. Geographically, Eastern as well as northern states have very good irrigation facilities, as compare to western and southern states (Fig.8). Punjab has all most all area under assure irrigation; hence its top the productivity in food grain production, opposite trend was notice in case of irrigation facility extended and food crop productivity by Maharashtra (Fig. 9). It is worth to mention here that states like Maharashtra and Karnataka posses' reservoirs, but due to poor and erratic monsoon rains the reservoir water level is almost every year below the bench mark and not getting it filled. Contrary to this situation in case of Eastern and Northern part face unique problem of perennial floods, particularly during monsoon. With the river linking projects, excess water available during monsoon in the north and eastern states, can be managed simply by diverting it, to south and western states. Our motto should be "Per Drop More Crop and Har Khet Ko Pani"

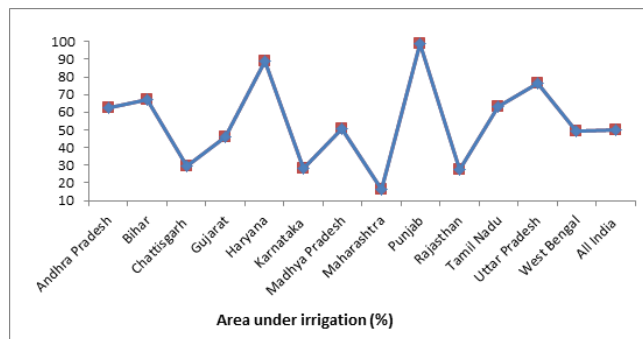


Fig. 9: Area under irrigation (%)

3. Feed the soil to feed the crop: Balancing the imbalance of soil fertility to improve productivity

Our motherland have been feeding us since the dawn of agriculture and producing crops over thousands of years without taking break, without caring much for replenishing. This has led to depletion of minerals essentially requires not even for successful crop production but also for completion of

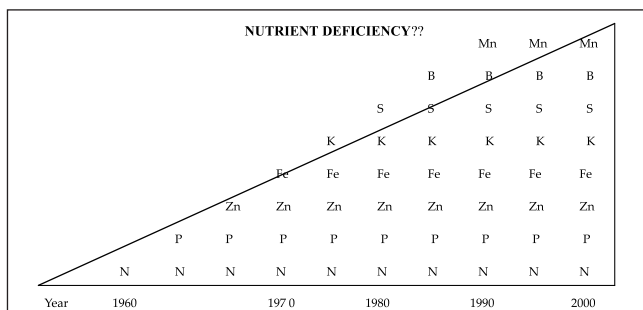


Fig 10: Progressive expression in the occurrence of nutrient deficiencies in northern India

Source: Aborl (2002)

life cycle, exhaustion of soil fertility resulting in their low productivity (Singh and Kumar, 2009). Deficiency of Nitrogen mineral in soil root zone was first established in 1960, as many as 9 wide spread mineral deficiency in the soil has been reported till 2000 (Fig. 10) The average yields of almost all the crops are among the lowest in the world. This is a serious problem which can be solved by using more manures and fertilizers. There is need to feed the soil to feed the crop for improving imbalance of soil fertility to improve productivity. A very good initiative has been taken by Government of India by launching massive scheme for preparation of fertility status of each and every field in the name of soil health card.

4. Empowering farmers through Agromet Advisory Services

India is one of the most vulnerable country apart from Africa and Sub Sahara In the era of global warming and climate change, obviously due to diversity in its agroclimatic condition and multidimensional agricultural canvas. Uncertainty is the key feature under this circumstance, leading to biotic and abiotic stress viz., outbreak of diseases and insect pests as well as untimely heavy downpour and drought etc (Mishra *et al.*, 2013). Keeping in view of the important role, India Meteorological Department (IMD) started Integrated Agro-Meteorological Advisory Service (IAAS) in the country for the benefits of farmers. The main aim of Agro met Advisory Services is to conserve the natural resources effectively and call for minimizing the weather hazards. As of now The Agromet Advisory Bulletins are issued at district, state and national levels. Above services in form of bulletins greatly helping to identify the distressed districts of the state as well as plan the supply of appropriate farm inputs such as seeds, irrigation water, fertilizer, pesticides etc. Most of the AAS farmers have realized higher additional benefit of 28.18% and 18.53%, in finger millet and red gram crops, respectively (Singh *et al.*, 2004 and Venkataraman 2004). It forms a significant input to the State level weekly Crop Weather Watch Group (CWWG) meeting and used by state government line function departments viz: Fertilizer industry, Pesticide industry, Irrigation Department, Seed Corporation, Transport and other organizations which provide inputs in agriculture. Apart from this there is need to strength the action plan according to the advisory, to make this service in practical utilities, which is somehow not up to mark due to numerous reasons.

5. Strengthening and extension of the MSP for Remunerative Prices for Farmers

There is need to build confidence among the farmers in respect to fetching remunerative prices to their farm produce. Efficient and effective implementation of minimum support price (MSP) is keys to success in this regards. Since MSP effectively applies to a rice, wheat and cotton, it's only available in a producer states. In the states in which no procurement is done by the public agencies at the MSP, farmers lack the guarantee offered by the MSP (Planning Commission, 2007). Further, due availability of food grain at cheaper price under public distribution system (PDS), poor farmers are force to sell their produce by artificially lowering the price. Such type of marketing arrangements under these

acts have undermined the interests of the farmers and benefited the intermediaries (Chand 2012; Gulati 2013).

6. Contact and cooperative farming is needs of hour's courtesy small land holding size

In Indian, small land holding size coupled with numerous numbers of operational areas is one of the major hurdle to make agriculture productivity and as well as profitable enterprising (CMIE, 1997). Since, 85% of holdings belongs to small and marginal category holding, with average land holding size is <1.50 acre (Fig.11), under this circumstance estimated 5-6% of limited fertile land is wasted for filed bund purposes. Further, average Indian land holding size is around 2.84 acre (Table 7). If India wish to be proud and develop Nation in near future, India have to have go for contact and cooperative farming which is not only going to solve the above problem through, but this will also lead mechanization of Indian Agriculture, and diversion of work force to other sector be it service or industry.

Table 7: Land holding size and operational area

Holding Size	Numbers of Holding (%)	Average Holding (Acre)	Operational Area (%)
Marginal	67.1	0.96	22.5
Small	17.91	3.51	22.08
Semi Medium	10.04	6.69	23.63
Medium	4.25	14.23	21.2
Large	0.7	42.93	10.59
All Size	100	2.84	100

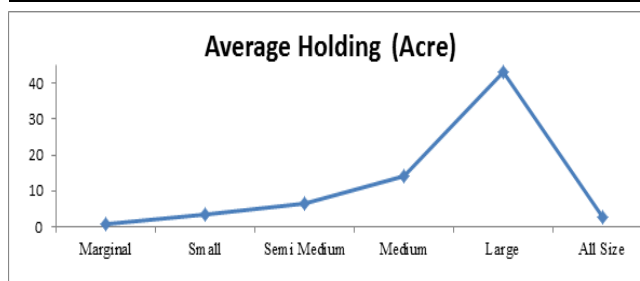


Fig 11: Average Holding (in Acre)

7. Natural catastrophe and instant and direct relief

Natural calamity such as droughts, floods, cyclones, storms, landslides, hails and earthquakes are frequently and every time our agricultural activities are at receiving end. Framers get affected because most farmers lead subsistence existence; such disasters can lead to extreme distress and hardship. Though some crop insurance schemes have been tried in the past, they have not worked effectively (Raju and Chand 2007).

8. Bringing the Green Revolution to Eastern States

First Green revolution had clear-cut impact on north western part of India and limited to great extent to the rice and wheat only. First ever Green Revolution began in mid-1960s through the introduction of new high yielding varieties of wheat and rice, turned India from 'Begging bowl to 'Grain bowl'. The majority of the areas in these states have a length of growing period of 240 days or more, which is adequate to support double cropping (Bhatt *et al.*, 2013). Since eastern states has missed the first ever green revolution bus, now it's high time

to pay attention to the problems of farmers of these uncovered states of India (Singh *et al*, 2015). These states are rich in natural resources viz., fertile land and abundant water resources along with favourable climatic conditions, termed as high potential in agriculture region. However, their agricultural productivity is less than the national average. Therefore, strenuous attempt is necessary to bring the Green Revolution to these states (Gulati, Gujral and Nandakumar 2010).

9. Time to go for mechanization

India is 2nd largest country just after USA and ahead of china with respect to arable land, though it is marginally in either way. India enjoys diversity in climates and ecological parameter to support the growth of various crops (Singh and Kumar, 2009). Over, the years, promotion of agricultural mechanization has been directed towards the promotion of eco-friendly and selective agricultural implements and machines with the aims of optimal utilization of the available sources of human, animal and mechanical/electrical power, removing the drudgery associated with various agricultural operations. Farmers have also been provided financial assistance for owning a wide range of agricultural equipment viz. tractors, power tillers, bullock/tractor drawn implements, reapers, threshers, irrigation equipment, hand tools, etc (Kulkarni, 2005). Keeping in view above facts Indian agriculture has insufficient and outdated Infrastructure, handicapped post management of crops and no schematic and structural measures against floods and droughts (Pandey, 2009). However, sectorial, large scale mechanisation of agriculture in some parts of the country, most of the agricultural operations in larger parts are carried on by human hand using simple and conventional tools and implements like wooden plough, sickle, etc. Mechanisation is one the major hurdle where Indian agriculture is showing very slow progress. In India mechanisation means only tractors and harvesters (in limited states). There are no doubt tractors sales are increasing year by year (Kulkarni, 2005 and Ali, 2005). We are still far behind to develop mechanization for small and marginal land holding size field. Most of the Indian farmers are having sufficient time to implement other sources of income.

10. Revisiting policy of low Investment on Research work

India is very shy on spending on agricultural Research and education by centre or states, since agriculture is state subject responsibilities for all round development is vested in the respective state government. Expenditure on agriculture

Education and research is also very low and compare to income it is 0.70% only (Table 8). To cope up with the challenges of modern ear agriculture especially under the climate change scenario, there is urgent need to strengthen our research and development activities. To meet out targeted agricultural growth on long-term basis, Indian Government should increase expenditure in agricultural research and education by huge margin.

Table 8: Expenditure on Agricultural Research and Education in 11th Plan

Particulars	Magnitude
Expenditure on Agricultural Research and Education by Centre and States (Rs Crore)	28351
GDP Agriculture and Allied (2006-07 price) (Rs Crore)	3982837
Research and Education as % of GDP	0.71%

Source: NITI Aayog, 2015

CONCLUSION

Cereals and coarse cereals will not only strengthen the National food security but will also contribute in world food security in coming years. Indications are very clear, as of now India turns Net exporter from Net Importer. It is worth mentioning here that, during nineteen sixties, agriculture and allied sector production were at same levels in China and India. Chinese agricultural area has stagnated after increasing till the 1980s, now it has created a wide gap between India and China production levels. China's surge ahead of India in agricultural has been achieved by improvement in yields and not increase in agricultural area. If India wishes to be cereal power on global arena, there is need for sensitization towards the technological backstopping for raising productivity bar, land reforms and vibrant land policy, remunerative price for farmers by strengthening and extension of minimum support price supported by assured procurement of farmers produce. Mechanism for dealing with natural calamity and distress for immediate rescue by extension of relief needs to be developed. Some good programmes have been launched by central government for technical backstopping, Soil Health Card , farmers First, Student Reddy, Mera Gaon Mera Gaurav, Arya and area specific programmes like Bringing the Green Revolution to Eastern States etc. In nut shell, Indian Cereal Saga is bound to achieve new glory with passage of timing, since there is no point of return, except marching ahead.

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