International Journal of Advance Research in Science and Engineering
Volume No.06, Special Issue No.(01), Nov 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

Analysis of Trends in India's Agricultural Growth

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The present study discusses the trends and patterns in agricultural growth at the national levels in India. Data on important variables like area, production, input use and value of output were compiled for the period 1967-68 to 2007-08 from various published sources. The analysis of data reveals that the cropping pattern in India has under gone significant changes over time. There is a marked shift from the cultivation of food grains to commercial crops. The use of technological inventions in the cultivation of other crops was also not so conspicuous in pulses. Nevertheless, the increase in crop yield has been a major factor for accelerating production in the country since the late 1960s. The use of modern varieties, irrigation and fertilizers were important factors that ensured higher growth in crop production. However, technological and institutional support for a few crops like rice and wheat brought significant changes in crop area and output composition in some regions. The results of crop output growth model indicate that the enhanced capital formation, better irrigation facilities, normal rainfall and improved fertilizer consumption helped to improve crop output in the country.

I. INTRODUCTION

Agriculture is an important sector of Indian Economy as more than half of its population relies on Agriculture as principle source of income. Research and Extension systems play major role in generation and dissemination of Agricultural technologies aiming at enhancing the income of farmers. The extension system adopts series of extension methods such as Training, demonstration, exposure visit to transfer the technologies from lab to land. Majority of these extension efforts mainly focus on location and crop specific technologies, and mostly on solution to problem basis. However, there is a need for equipping the farmers with Basic knowledge of Agriculture in order to create a better knowledge platform at farmer level for taking appropriate farm management decisions and to absorb modern technologies.

As a source of livelihood, agriculture (including forestry and fishing) remains the largest sector of Indian Economy. While its output share fell from 28.3% in 1993-94 to 14.4% in 2011-12, employment share declined from 64.8% to 48.9% over the same period. Therefore, almost half of the workforce in India still remains dependent on agriculture. Given the low share of this workforce in the GDP, on average, it earns much lower income poorer than its counterpart in industry and services.

Therefore, progress in agriculture has a bearing on the fate of the largest proportion of the low income population in India. The paper identifies five important aspects of agriculture that need immediate attention to bring economic advantages to millions of farm families. First, output per hectare, which is a common measure of agricultural productivity, remains low for many crops when compared to many other countries. There are also large regional variations within the country. Reasons include low and faulty input uses, poor access to modern technology and no real technological breakthrough in recent times. Second, on average, farmers do not realize remunerative prices due to limited reach of the minimum support prices (MSP) and an agricultural marketing system that delivers only a small fraction of the final price to the actual farmer. Third, the farm size of the majority of the household has declined to unviable levels inducing farmers to leave land and look for better job opportunities elsewhere. Because land-leasing laws make it risky to lease land, increasingly, productive land is being left uncultivated. Changes in the land leasing laws may bring consolidation of land holding at operational level and attract better investment along with access to credit and relief to tenants. Fourth, relief measures in the event of natural disasters are inadequate and suffer from procedural inefficiencies and delays. The risk adaptation measures are poorly executed and have not worked effectively. This situation needs to be rectified with at least minimum quick relief to farmers for crop loss in case of natural calamities. Finally the potential of the eastern region needs to be harnessed with suitable interventions. This region is unique for its suitability to the production of certain commodities. However, taking advantage of this potential would require institutional support and investment in technological innovations. The paper offers ideas on how these problems can be addressed so as to accelerate agricultural growth and bring remunerative prices to farmers.

II. THE CURRENT STATUS OF INDIAN AGRICULTURE

Since 1970-71, trend growth in Indian agriculture has been approximately 3%, above that in population but well below that in the entire economy consisting of agriculture, industry and services. By implication, while per-capita agricultural output has seen a steady rise, the share of agriculture in the Gross Domestic Product (GDP) has fallen. The rise in per-capita agricultural production has gone a long way toward easing pressure on meeting food and nutrition security of the country. Unfortunately, however, growth in agricultural output is characterized by fluctuations; each high growth period is followed by a phase of low growth. This cyclical pattern has reflected itself in 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. Specific sub sectors, most notably crop segment, are subject to occasional severe negative shocks leading to serious distress.

Crop production in the country is dominated by cultivation of paddy in Kharif and wheat in Rabi seasons. These two crops cover about 38 per cent of gross cropped area in the country. Cereals including coarse cereals occupy more than half of the total land under cultivation.

Table 1: Distribution of gross cropped area across major crops

Table 1: Distribution of gross cropped area across major crops Year	TE 2001-02	TE 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

Table 1 provides the distribution of gross cropped area over important crops and crop groups and changes in crop pattern at the turn of the new Century and currently. The table shows that there has been some shift in area away from cereals during last 12 years. Between triennium ending (TE) 2001-2 and TE 2013-14, area under cereal declined from 54% to 51 per cent while that under pulses rose slightly from 11.3 to 12.5%. Area share of fruits and vegetables witnessed significant increase but it still remains below 10%.

Table 2 provides the area, production, yield and per cent area irrigated in food grains in different states of India. Uttar Pradesh accounts for the largest share by area as well as production by a wide margin. It accounts for almost one-fifth of the country's food grain production. While Punjab and Haryana have been traditionally seen as the major contributors to food grain production, Madhya Pradesh, Andhra Pradesh, Rajasthan and West Bengal have emerged as significant producers in recent years.

Table 2: Area, production and yield in food grain in 2013-14 and the proportion of area under food grains irrigated in 2011-12

State	Area (m. Hectares)	Per cent of India	Production (million tonne)	Per cent of India	Yield (kg per hectare)	% Area irrigated (2011-12)
Uttar Pradesh	20.23	16.05	50.05	18.9	2474	76.1
Punjab	6.56	5.2	28.9	10.92	4409	98.7
Madhya Pradesh	14.94	11.85	24.24	9.15	1622	50.5
Andhra Pradesh	7.61	6.04	20.1	7.59	2641	62.5
Rajasthan	13.42	10.64	18.3	6.91	1364	27.7
West Bengal	6.24	4.95	17.05	6.44	2732	49.3
Haryana	4.4	3.49	16.97	6.41	3854	88.9
Maharashtra	11.62	9.22	13.92	5.26	1198	16.4
Bihar	6.67	5.29	13.15	4.97	1971	67.4
Karnataka	7.51	5.95	12.17	4.6	1622	28.2
Tamil Nadu	3.55	2.81	8.49	3.21	2396	63.5
Odisha	5.15	4.09	8.33	3.15	1617	29.0
Gujarat	4.29	3.4	8.21	3.1	1917	46.0
Chhattisgarh	4.95	3.93	7.58	2.86	1532	29.7
Assam	2.53	2.01	4.94	1.87	1952	4.6
Jharkhand	2.24	1.77	4.19	1.58	1874	7.0
Uttarakhand	0.89	0.71	1.78	0.67	2001	44.0
Others	3.26	2.59	6.38	2.41	-	
All India	126.04	100	264.77	100	2101	49.8

Yields and the proportion of area irrigated vary widely across states. Predictably, there is a strong correlation between these two variables. Punjab ranks the first and Haryana the second in terms of both variables. Among larger producers, Madhya Pradesh, Rajasthan and Maharashtra show relatively low yields. Rajasthan and Maharashtra also exhibit low proportions of area under irrigation. In Bihar,

the proportion of area irrigated is above the national average but not the yield. This is very likely due to high frequency of floods that occasionally destroy standing crops.

The international comparison of yields and share in world's output in rice, wheat and horticultural crops are presented in Tables 3, 4 and 5, respectively. The countries are ranked according to declining share in the output in each table. In terms of the total output, India ranks second in rice, wheat and potato with China ranking the first. In banana India ranks first followed by China.

India exhibits low yields in rice when compared to other countries but not in wheat. Rice yield in India is just 55% of rice yield in China. Average yield of rice in India is much lower than other major rice producing countries like Bangladesh, Indonesia and Vietnam.

Table 3: Country comparison of yields and shares in the world output in rice in 2012

Country	Yield (kg per hectare)	Production (% of world)	Country	Yield (kg per hectare)	Production (% of world)
World	4548	100	Pakistan	4068	1.27
China	6775	27.9	Cambodia	3089	1.26
India	**3721**	**21.38**	USA	8349	1.23
Indonesia	5136	9.35	Korea, Republic	6988	0.8
Bangladesh	4421	6.84	Egypt	9530	0.8
Viet Nam	5631	5.91	Nepal	3312	0.69
Thailand	3051	5.08	Nigeria	1800	0.65
Myanmar	3445	3.8	Madagascar	2938	0.62
Philippines	3845	2.44	Sri Lanka	3885	0.52
Brazil	4786	1.56	Iran	5000	0.33
Japan	6739	1.44	Russian Federation	490	0.14

It may seem surprising but India edges out the United States in yield per hectare in wheat. China is the major producer of wheat that has far higher productivity than India. France, Germany and the United Kingdom exhibit super-high productivity in wheat but their contributions to the world output are significantly smaller than those of India and China.

Table 4: Country comparison of yields and shares in the world output in wheat in 2012

Country	Yield (kg/ha)	Production (% of world)	Country	Yield (kg/ha)	Production (% of world)
World	3090	100	Iran	1971	2.06
China	4987	18.02	UK	6657	1.97
India	**3177**	**14.13**	Kazakhstan	683	1.47
USA	3115	9.19	Egypt	6582	1.31
France	7599	6	Poland	4144	1.28
Russian Fed.	1773	5.62	Argentina	2715	1.22
Australia	2215	4.45	Italy	4132	1.16
Canada	2865	4.05	Romania	2659	0.79
Pakistan	2709	3.5	Spain	2644	0.69
Germany	7328	3.34	Syrian Rep.	2252	0.54
Ukraine	2800	2.35	Bangladesh	2779	0.15

Table 5: Country comparison of yields and shares in the world output in horticultural crops in 2012

Potato			**Banana**		
Country	Yield (kg/ha)	Production (% of world)	Country	Yield (kg/ha)	Production (% of world)
World	18900	100	World	21200	100.00
China	16100	23.88	**India**	**37000**	**27.82**
India	**21100**	**11.37**	China	26400	9.87
Russia	13400	8.08	Philippines	20300	8.63
Ukraine	16100	6.36	Ecuador	33300	6.56
USA	45800	5.74	Brazil	14300	6.46
Germany	44800	2.92	Indonesia	58900	5.79
Poland	24400	2.49	Angola	25800	2.80
Bangladesh	19100	2.25	Guatemala	40900	2.53
Belarus	20800	1.89	UR of Tanzania	5700	2.36
Netherlands	45200	1.85	Mexico	30300	2.06

India is fairly placed in terms of contribution to global production of potato and banana but there also the level of productivity is less as compared to many countries. In potato the productivity of India is less than half of the productivity of USA, Germany and Netherlands while yield of banana in Indonesia is 1.5 times higher than that of India.

III. ISSUES CONFRONTING INDIAN AGRICULTURE

Indian Agriculture is confronted with several issues. After careful deliberations, the Task Force on Agricultural Development chose to concentrate on five major issues: agricultural productivity, remunerative prices for farmers, land policy, agrarian distress and eastern states that have lagged behind the rest of the country in farming. These issues are summarised immediately below with a more detailed dissection and associated policy recommendations provided in subsequent sections.

First, a series of essential steps are required to raise agricultural productivity. At a broad level, this issue has two aspects: low average productivity at the national level and high variation in it regionally. As explained earlier, the average productivity in rice is low relative to most of the major rice producing counties. India does better in wheat but the scope for improvement exists in this crop as well. The same goes for other crops including oilseeds, fruits and vegetables as well as activities such as animal husbandry, fisheries and poultry. The second broad productivity concern relates to regional variation. It is also evident that while Punjab and Haryana exhibit high productivity nationally, states such as Madhya Pradesh, Rajasthan, Maharashtra, Chhattisgarh, Odisha, and Karnataka suffer from quite low yields per hectare. The scope for improved productivity in these latter regions is substantial.

To increase productivity, progress is required along three dimensions: (i) Quality and judicious use of inputs such as water, seeds, fertilizer and pesticides; (ii) judicious and safe exploitation of modern technology including genetically modified (GM) seeds; and (iii) shift into high value commodities such as fruits, vegetables, flowers, fisheries, animal husbandry and poultry. In the longer run, productivity enhancement requires research toward discovery of robust seed varieties and other inputs, appropriate crops and input usage for a given soil type and effective extension practices. Second, farmers need to be ensured to receive remunerative prices. This issue has two aspects, one relating to the Minimum Support Price (MSP) and the other relating to the farmer's share in the price paid by the final consumer. Taking the MSP first, it effectively applies to a specified set of commodities, predominantly rice, wheat and cotton, and is available only in a subset of 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 (Chand 2003, Planning Commission 2007). Moreover, subsidized sales of cereals under the public distribution system (PDS) divert part of the demand thereby artificially lowering the price at which they must sell their produce. Likewise, for commodities such as fruits and vegetables, which are not subject to any procurement by official agencies, sometimes the market price can be excessively low due to perish ability and localized nature of markets for them. The inadequate cold storage facility makes matters worse by discouraging farmers from opting for these crops in the first place. Agricultural marketing has not seen any significant

reforms and modernization for decades. The supply chain remains fragmented, scale of operations is low and there is excessive presence of intermediaries. The poor state of competitiveness is more pronounced during above normal or below normal production. A small increase in production above normal level often results in price crash for farmers and a below normal production is followed by skyrocketing prices in the post-harvest period with hardly any benefit for the farmers.

The second aspect of the price received by the famer concerns the small fraction of the price paid by the final consumer that the farmer receives in the marketplace. The continued presence of regulations flowing from the Agricultural Produce Marketing Committees (APMC) Acts in most commodities in most states has meant that the farmer is compelled to sell her produce in the government-controlled marketing yards. These controls restrict transactions to the handful of local players and easy manipulations

Third, for understandable historical reasons, land leasing laws in India have taken forms that discourage formal leasing contracts between the owner and the tenant. Field studies have shown that most of tenancy in the country is concealed and, thus, unofficial. This fact has the implication that tenants are often not identified as actual cultivators in the records. The lack of identification of tenants as actual farmers has very serious implications for the conduct of public policy. Benefits intended for the tenant farmer such as disaster relief or direct benefit transfers risk being disbursed to the owner of the land who appears as the cultivator in the official records. In the absence of official records, tenants also lack access to formal credit and other benefits available to cultivators. In many states, leasing laws can effectively result in the loss of land to the tenant leading owners to eschew leasing land altogether

IV. ACCESS TO AGRICULTURAL CREDIT AND INSURANCE

Access to agricultural credit is linked to the holding of land titles. As a result, small and marginal farmers, who account for more than half of the total land holdings, and may not hold formal land titles, are unable to access institutionalized credit.25 Farmers may require credit for short term uses such as purchasing inputs, weeding, harvesting, sorting and transporting, or long term uses such as investing in agricultural machinery and equipment, or irrigation. Table 4 shows the distribution of agricultural loans according to sources, as of 2013.

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E-Bhoomi project in Karnataka: The E-Bhoomi project was started by the Government of Karnataka in the early 2000s. The project aims to computerize existing land records and create a transparent system for changing land records and dividing or merging plots of land. Under the system, farmers can collect land record information for their plot at the Tehsil level, called Pahani. These records would contain information such as the survey number of the land, land owner's details, the classification of the soil, and details regarding irrigation and crops grown, among others. The Pahani would enable the farmer to (i) know whether the plot he wants to purchase is genuine, (ii) raise farm credit from banks, (iii) use the land records for official or legal purposes. E-Bhoomi also allows farmers to approach the government to address grievances.

Bargadar system in West Bengal: The West Bengal Land Reforms Act, 1955 provides certain rights to Bargadars or land tenants.

Bargadars are persons lawfully cultivating any land belonging to another person (who is not a family member). Under the Act, produce from the farm is divided between the tenant and owner in a 50:50 proportion if the cattle, manure and seeds are provided by the landowner, and 75:25 in all other cases. Illegal eviction of tenants is a cognizable offence punishable with imprisonment or fine, under the Act. However, it does not provide any ownership rights to the tenant.

Short term and long term credit: Short term credit is generally taken for pre-harvest and post-harvest activities such as weeding, harvesting, sorting and transporting. Long term credit is generally taken in order to invest in agricultural machinery and equipment, irrigation and other developmental activities, etc. Over the past few decades, the trend of short term and long term agricultural credit in the country has reversed.

In 1990-91, a majority of crop loans taken was long term credit, whereas short term credit accounted for only about a quarter of all agricultural loans.26 As of 2011-12, 61% of crop credit was short term, whereas long term credit had a share of 39%.

Inadequate access to crop insurance: As of 2011, about 10% of Indian farmers were covered under a crop insurance scheme.28 Some persistent issues with the crop insurance system include (i) unawareness about insurance schemes, (ii)

inadequate coverage of insurance schemes, (iii) assessment of the extent of damages in case of crop losses, and (iv) timely settlement of claims. Standing Committee on Finance has recommended that assessment of crop damage should be completed and compensation should be deposited directly into farmers' accounts in a timely manner.In addition, to reduce the seeking of unproductive credit, the government should create awareness about what crops should be grown based on the quality of soil and incidence of rainfall, etc. in different regions.

Pradhan Mantri Fasal Bima Yojana: The Pradhan Mantri Fasal Bima Yojana was launched by the central government in January 2016. The scheme aims to provide insurance coverage to farmers for crop failure, stabilize farmers' income, and encourage farmers to adopt modern agricultural practices, among others. The scheme has been allocated Rs 9,000 crore in the Union Budget 2017-18, compared to Rs 5,501 crore in 2016-17.The scheme covers all farmers, including tenant farmers and sharecroppers, who are growing notified crops in notified areas. It covers crops such as cereals, pulses, oilseeds, vegetables, and spices.

Availability of water: Currently, about 51% of the agricultural area cultivating food grains is covered by irrigation.36 The rest of the area is dependent on rainfall (rain-fed agriculture). Sources of irrigation include ground water (wells, tube-wells) and surface water (canals, tanks). The various sources of irrigation used in agriculture.

 There is a need to improve the efficiency ofwater use, especially in agriculture. Irrigation currently consumes about 84% of the total available water in the country.

 Nearly 65% of the irrigated land holdings use ground water sources such as tube wells and wells for irrigation.

The past few decades has led to an overuse of ground water sources in states, especially those growing water intensive crops such as rice. For instance, in Haryana and Rajasthan, 40%-75% of the ground water units are over-exploited, and the situation is worse in Punjab, where 75%-90% of ground water units have been over-exploited.

The Commission for Agricultural Costs and Prices has recommended that quantitative ceilings should be fixed on the per hectare use of water. In addition, farmers using lesser water than the ceiling fixed should receive money equivalent to remaining units of water at the current domestic costs. This would incentivize them to ration their use of water.

Micro-irrigation techniques: The Economic Survey 2015-16 observed that India largely uses the technique of flood irrigation, where water is allowed flow in the field and seep into the soil. This results in the wastage of water since excess water seeps into the soil or flows off the surface without being utilized. It has been recommended that farmers should move from flood irrigation to the drip or sprinkler irrigation systems (micro irrigation). This would help in conserving water as well as save on the cost of irrigation. Using micro-irrigation systems (such as drip or sprinkler irrigation) has also been linked to an increase in the yield of crops.

V. SOIL AND FERTILIZERS

Quality of soil: Soil is one of the most important factors in the productivity of agriculture. Indian soil consists of primary nutrients such as nitrogen, phosphorous and potassium, secondary nutrients such as sulphur, calcium and magnesium, and micro-nutrients such as zinc, iron, and manganese. While the levels of

food production have increased over the past few decades, it has also led to issues such as an imbalance of nutrients in the soil, decline in the water table as well as the quality of water, and overall depletion of soil health. The Ministry of Agriculture has noted that the quality of Indian soil is deteriorating. About 5.3 billion tonnes of soil gets eroded annually, at a rate of about 16.4 tone hectare.

Imbalance in use of fertilizers: The manufacture, sale, and distribution of fertilizers in the country is regulated by the Ministry of Chemicals and Fertilizers, under the Essential Commodities Act, 1955. There are three major types of nutrients used as fertilizers: Nitrogen (N), Phosphate (P), and Potash (K). Of these, the pricing of urea (containing N fertilizer) is controlled by the government, while P and K fertilizers were decontrolled in 1992, on the recommendation of a Joint Parliamentary Committee. It has been observed that urea is used more than other fertilizers. While the recommended ratio of use of the NPK fertilizers is 4:2:1, this ratio in India is currently at 6.7:2.4:1.6 Overuse of urea is especially observed in the states of Punjab, Haryana and Uttar Pradesh.6 Figure 7 shows the trend in the consumption of fertilizers over the past decade.

Fertilizer subsidy: To promote the use of fertilizers by farmers, the central government provides a fertilizer subsidy to the producers of fertilizers. In 2017-18, Rs 70,000 crore has been allocated for fertilizer subsidy, which is the second biggest expenditure on subsidy after food subsidy.32Allocations for fertilizer subsidy have been increasing at an annual rate of
11.4% between 2000 and 2016. Of the subsidy allocated for 2017-18, Rs 49,768 crore has been allocated for subsidy on urea. The trend in the fertilizer subsidy 2000-01onwards.
Currently the amount of subsidy to be given is determined based on the cost of production of the fertilizer company.49 Companies with a higher cost of production receive greater subsidies. This reduces the companies' incentive to reduce their cost of production. Although the consumption of urea has been increasing over the past decade, no new domestic production capacity has been added in the past 15 years.

Use of pesticides: The consumption of chemical pesticides in the country has increased over the past few years, from 55,540 tonne in 2010-11 to 57,353 tonne in 2014-15.54 Over this time period, the imports of pesticides also increased from 53,996 tonne to 77,376 tonne. Issues with regard to the use of pesticides include use of low-quality pesticides, and a lack of awareness about pesticide use. The Economic Survey 2015-16 noted that the use of pesticides without proper guidelines has led to an increase in pesticide residue being found in food products in India.

Nutrient based subsidy policy: The central government launched the nutrient based subsidy policy (NBS) in 2010 for P and K fertilizers. The policy was formulated with the objective of promoting a balanced use of N, P and K fertilizers. The policy allowed the manufacturers of P and K fertilizers to fix their maximum retail prices (MRPs) at reasonable levels. The subsidy provided would be based on per kilogram of the nutrient. The policy also provided for an additional subsidy to be paid to indigenous manufacturers of fertilizers. The Comptroller and Auditor General of India, in its report on the performance of the NBS policy stated that in the five years since its implementation, the policy had not succeeded in bringing about a balanced use of fertilizers. The fertilizer usage ratio of urea increased from 4.3 in 2009-10 to 8.2 in 2012-13.

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Agricultural machinery: Mechanization is another aspect with a significant impact on agricultural productivity. The use of agricultural machinery in agriculture enables agricultural labour to be used in other activities. It makes activities such as tilling, spreading of seeds and fertilizers and harvesting more efficient, so that the cost of inputs is offset. It can also make the use of labour in agriculture more cost-effective.
The status of mechanization in agriculture varies for different activities, although the overall level of mechanization is still less than 50%, as compared to 90% in developed countries.62 The highest level of mechanization (60%-70%) is observed in harvesting and threshing activities and irrigation (37%).
The lowest level of mechanization is found in seeding and planting.

Genetically modified seed varieties: Genetically modified (GM) seeds are those where certain genes are modified to develop traits such as a resistance to pests and herbicide, and increased productivity. Bt cotton is currently the only approved GM technology seed in India. It was adopted in India in 2002 and as of 2014, 92% of the area covered by cotton uses Bt cotton.57 After releasing Bt cotton in the country, the crop's yield increased from 190 kg/ha in 2000-01 to 461 kg/ha in 2014-15.58

Over the years, various GM crops such as Bt brinjal have been developed, but they have not received the regulatory approval to be released in Indian markets. Under the existing regulatory process, the Genetic Engineering Appraisal Committee (GEAC) under the Ministry of Environment, Forest and Climate Change, approves proposals for the commercial use of GM seeds.59 In September 2016, the GEAC invited public comments on a report authorising the environmental release of GE mustard.60,61

The Ministry of Environment is yet to provide the final approval for GE mustard to be released commercially.

Post-harvest activities

Storage facilities: After agricultural produce is harvested, it requires a robust storage infrastructure in order to minimize any losses due to adverse weather conditions or in the process of transportation. The quantity of food which is wasted during the harvest and post-harvest processes in the country has increased over the past five years.18 The highest losses are observed in the case of fruits and vegetables (4.6%-15.9% of production in 2015), pulses (6.4%-8.4%) and oilseeds (5.3%-9.9%).

Food wastage occurs at all levels of farming- the farmer, transporter, wholesaler and retailer. Some of the reasons for this wastage are crop damage, improper harvesting techniques, poor packaging and transportation, and poor storage. Some of the issues with the state of storage facilities in the country are inadequate capacity and poor conditions of storage.64 In cases where the storage capacity is found to be sufficient, the conditions of the godown are unfit, either because of the damp condition of the storage or because of its remote location.

Agricultural Pricing: Procurement of agricultural commodities is the purchase of food grains by the central or state governments. The Food Corporation of India is responsible for the purchase, storage, movement, distribution and sale of agricultural produce. Minimum Support Prices are the prices at which the government purchases food grains from farmers.

The largest procurement at MSPs is for rice and wheat. About a third of the wheat and rice produced in the country is procured by the central government. In 2015-16, 33% of the wheat and 30% of the rice produced in the country was procured by the central government. Note that India is a big exporter of wheat; in 2014-15, of the 90.8 million tonnes of wheat produced in the country, 28 million tonnes was procured for the central pool, and 29 million tonnes was exported.

Minimum Support Prices (MSPs): MSPs are the prices at which the central government purchases food grains from farmers. MSPs are fixed by the central government in order to ensure remunerative prices to farmers. Factors taken into consideration in determining MSPs include costs of cultivation and production, productivity

of crops, and market prices.73 High MSPs of crops provide incentives to farmers to adopt modern technologies and farming practices, to increase the overall productivity of their crops. The government announces MSPs for 22 crops (and a fair and remunerative price for sugarcane), but the Public Distribution System, for which grains are procured, primarily distributes wheat and rice to its beneficiaries. Since procurement is mainly carried out for wheat and rice, farmers have focused on the cultivation of these crops over other crops such as pulses and oilseeds.37 Table 17 in the Annexure shows the MSPs for crops from 2005-06 to 2015-16.

Agricultural markets: The production, supply and distribution of certain commodities comes under the purview of the Essential Commodities Act, 1955. These commodities include food grains, oilseeds, cotton and woollen textiles, jute, and coal, among others. Under the Act, the central government may control the price at which any essential commodity is traded. It may also regulate licenses for its storage, transport, distribution, disposal or consumption.

Agricultural markets in the country are regulated by state Agricultural Produce Marketing Committee (APMC) laws. Under these state Acts, farmers are required to sell their produce at state-owned mandis. Over the years, several issues have been highlighted in this system. For instance, APMC mandis currently levy a market fee on farmers who wish to sell their produce in the mandis. This makes it expensive for farmers to sell at APMC mandis. In addition, farmers have to arrange for their produce to be transported from their farms to the nearest mandi, which brings in costs such as transport and fuel. In transporting the produce from the farm to the store, several intermediaries are involved. These intermediaries are all paid a certain proportion of the price, as commissions. Thus the market price which the farmer receives for his produce is significantly lower than the price at which his produce is sold to the retailer.

VI. CONCLUSION

The present study has discussed the trends and patterns in the growth of the crop sector at the national levels. It has also estimated crop output growth model to analyze its determinants at the all- India level. The cropping pattern in India has undergone significant changes with a significant shift from

the cultivation of food grains to commercial crops. The area under coarse cereals, which is generally cultivated in dry regions, has declined by 13.3 per cent between TE 1970-71 and TE 2007-08. The performance of pulses in terms of area and output was not impressive during the study period.

Nevertheless, increase in crop yield has been a major factor for accelerating crop production in the country since late 1960s. The use of modern varieties, irrigation and fertilizers were important aspects of higher growth in crop production in the country. The crop output growth model indicates that the enhanced capital formation, better irrigation facilities, normal rainfall and improved fertilizer consumption will help to improve crop output in the country.

However, technological and institutional support for a few crops like rice and wheat have brought significant changes in crop area and output composition in some regions. Rice accounted for only 15.4 per cent of GCA in TE 1962-65 and it increased to 23 per cent in TE 2003-06 in North West

India. Similarly, wheat area almost doubled in these periods. The expansion of area under these two crops resulted in a contraction of area under coarse cereals, pulses and oilseeds in that region. In the central region, the share of cotton increased in the 1980s and constituted about 10 per cent of total value of crop output in recent years. Apart from this, the annual growth in yield during 1967-68 to 2007-08 for major crops was worked out to be low. In comparison with the FAO data, yield per hectare of rice in China was 6.56 ton and in USA it was 7.67 ton against the all-India average of 2.15 ton.

Similarly, the yield of wheat in China was 4.76 ton and in USA it was 3.02 ton against the all-India average of 2.71 ton. Hence, there is potential for enhancing yield of major crops through better soil and water management, profitable crop rotation, innovative marketing, genetic engineering and investment in farm education and rural infrastructure.

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