CHAPTER 2

Trends in Agricultural Production and Productivity Growth in India: Challenges to Sustainability

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Introduction

The theories of economic growth have traditionally revolved around the growth of the agricultural sector since it was believed that the production could happen only in agrarian structure and the production in the industrial sector is largely dependent on it for factor inputs. However, though the strategies of growth have been focused more on the industrial and service sectors since industrial revolution, the agricultural sector has not yet lost its dominance for the sheer reason that the requirements of basic needs can only be fulfilled from the output of the agricultural sector. In fact, in developing countries the agricultural sector continues to employ a significant proportion of the workforce. Indian agriculture, which stagnated during the first half of the twentieth century, witnessed significant growth and transformation soon after independence. The rate of growth accelerated from 0.37 per cent per annum during 1901–1944 to 2.88 per cent

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per annum during 1949–1950 to 2016–2017. This remarkable change was a result of vigorous policy interventions in the years of the Five-Year Plans of independent India. However, the major breakthrough in the rate of growth in Indian agriculture came with the green revolution in the late 1960s, which gave a boost to the agricultural sector and helped India become self-sufficient in food production.

There have been many theories behind the phenomenal achievement in Indian agriculture. The Boserupian argument for such stupendous turnaround in agrarian growth in India assumes prominence over all the theories considering India's higher growth in population until the 1970s. Though India is lagging far behind the developed countries in terms of productivity growth despite such a turnaround in the agricultural sector, India has traversed a long way from a hugely food-deficit country to a surplus country during the last four decades. The transition from a subsistence agrarian sector to a commercial surplus agricultural sector in India required large-scale investments and a complete transformation. However, the phenomenal growth that India has achieved especially in food-grains production and productivity is unequal across regions. There are states like Kerala and Punjab, where per hectare productivity has been more than 40 quintals, whereas states like Madhya Pradesh and Orissa have a productivity level of around 20 quintals. But the rise in prices of agricultural output is lagging behind any of the inflation indices like the Wholesale Price Index (WPI) or the Consumer Price Index (CPI). This eventually poses a serious threat to the sustainability of production in the agricultural sector as real wage increases (though quite a few other factor input prices do not rise due to subsidy) and makes farming not profitable. Though the productivity growth in the agricultural sector partly compensates for the loss due to rise in the real wage rate, rise in the prices of factor inputs and lack of a free market output price compromise the profitability aspect of the agricultural sector. As a result, required levels of private investments and entrepreneurship have been eluding the Indian agricultural sector. In the absence of a market-driven pricing system and lack of profitability in farm production, government policies like incentives will not be enough to sustain the production of agricultural output. This chapter makes an attempt to analyze productivity growth in the Indian agricultural sector and provide a policy framework to make activities of the farming sector, which employs two-thirds of India's workforce, profitable and sustainable.

An Overview of Literature on Agricultural Production and Productivity

There have been many studies on Indian agriculture analyzing the patterns of growth and productivity in the Indian context. In this section, attempt to review some of the most relevant studies that deal with agricultural growth and productivity as well as profitability in the agricultural sector in India. The study by Balkrishnan et al. (2008) analyzed the trends in production and productivity in the agricultural sector. The study observed the slow growth in the agricultural sector since 1991 and found that stagnation of public investment for almost a quarter century is one of the factors responsible for slow growth.

Dorward (2009) analyzed the role of conventional input subsidies in agricultural development in a theoretical framework by considering the effects of demand and supply inelastic ties in consumers' surplus and producers' surplus as well as the deadweight loss. He analyzed historical successes and failures of input subsidies for African economies and the role of subsidies in reducing profitability. In a neo-classical microeconomic framework, the impact of targeted subsidies on output supply was analyzed. The paper argues that stakeholders' welfare and subsidies have the greatest potential in contributing wider growth and increasing consumers' welfare via reduced food prices. Tripathi (2013) analyzed the impact of agricultural price policy on output and farm profitability in India. The paper argued that reduction in input subsidies to discourage environmentally unsustainable practices has slowed down the performance of the agricultural sector during the post-reform period. The study highlighted that agricultural price policy has ensured an increased farm income by the farmers. However, this study did not consider farm profitability in a free market equilibrium in the event of full withdrawal of subsidies on farm inputs.

Fan et al. (2007) examined the reasons behind the declining growth rate in Indian agriculture since the 1990s and empirically estimated the relative impact of various government subsidies and investments on growth and poverty reduction. This study also estimated returns in agricultural growth and poverty reduction to investments and subsidies and found that initial subsidies in credit, fertilizer, and irrigation helped farmers to adopt the new technologies. Authors found that the trade-off between agricultural growth and poverty reduction is generally small among different types of public spending and investments in agricultural research and infrastructure development have a large impact on economic growth and poverty reduction.

However, this study did not analyze the welfare loss and potential loss in farm profitability due to government provision of subsidies on farm inputs. Denning et al. (2009) analyzed the role of input subsidies in improvement of smallholder maize productivity in Malawi. The study found that pro-poor input subsidies work better for small farms and subsidies ensure that maize consumers are benefitting from lower prices though future challenges arise due to continuing surplus production. It may be noted here that subsidy-induced, lower-output prices pose a threat to the sustainability of production as the profitability for the farm is suppressed due to lesser prices of farm inputs. However, this study did not analyze the impact of input subsidies on farm profitability.

Grossman and Carlson (2011) analyzed the role of input subsidies in the agricultural policy of India. The study found that India's agricultural sector is more dependent on input subsidies than other large emerging economies like Brazil, Russia, and China. The study also found that despite inflation, the nominal prices of subsidized fertilizer in India are kept unchanged even though fertilizer prices increased all over the world due to political pressure from the farm sector, which accounts for half of India's population. There are various other studies like Balkrishnan (2000), Raghavan (2008), and Mahendra Dev (2000) that have highlighted economic reforms and their impact on Indian agricultural productivity growth in the context of changing patterns of input use. However, none of the existing studies analyzes farm profitability and the reasons for which the farming sector remains unattractive for private investments and private entrepreneurship. In this chapter, we attempt to analyze the factors influencing productivity stagnation and profitability in the Indian agricultural sector.

Objectives of the Study

The present study broadly examines the impact of subsidies on agricultural output prices and farm profitability. Specifically, the objectives of the study are:

- To analyze the trends in agricultural production and productivity growth in India since independence
- To examine the factors influencing agricultural productivity in India
- To examine the challenges faced by the agricultural sector in recent times in the context of MSP and provision of subsidies

Trends in Agricultural Production in the Post-Independence Era

Despite its continuous dwindling share in India's GDP, the agricultural sector remains the largest provider of jobs for the workforce. Even today, more than two-thirds of India's population is dependent on the agricultural sector for their sustenance. The agricultural sector has experienced phenomenal growth since the 1970s after two decades of slow growth soon after independence. Until the 1970s, due to a huge deficit of food, the primary focus of the first few Five-Year Plans was to achieve self-sufficiency in food-grains production. India had made huge investments in the agricultural sector and large-scale subsidies on inputs transformed the agricultural sector from a deficient sector to a surplus one.[1] The per capita availability of food grains increased from 348.15 grams per day in 1950–1951 to 528.09 grams per day in 2003–2004. Table 2.1 presents the trend in agricultural production (food grains) to allow for a better understanding of how India has progressed in terms of production since 1950–1951 to 2002–2003.

It is evident from Table 2.1 that production of food grains has undergone a transformation, changing the sector from a deficient to a surplus one over the years. The food-grains sector in India has moved from a deficient to sufficient, and further, to a surplus economy by registering very high rates of growth since the 1970s following the Green Revolution. However, growth in production of pulses has almost stagnated over the last two decades. Similarly, coarse cereals have not grown fast even though they have done better compared to pulses. Along with interventionist

[1] According to estimation of nutrition experts, the average daily requirement of cereals for an average Indian adult is 412.2 grams. For pulses, it is estimated to be 67.95 grams per day. Total requirement for cereals in the year 1950–1951(with a population of 361 million) was 54.31 million tons while production was 42.42 million tons, accounting for a deficit of 11.89 million tons, which is 28% of total production. Similarly, for pulses, the requirement was 8.95 million tons whereas production was 8.41 million tons, accounting for a marginal deficit of 0.54 million tons. For total food grains, the requirement was 63.26 million tons while production was 50.83 million tons, accounting for a deficit of 12.42 million tons. This resulted in an increase in import of food grains on a large scale, accounting for the bulk of the import bill. In addition, food security was under threat. Conversely, in the year 2015–2016, the total food-grains requirement was 232.28 million tons (with population of 1326 million) whereas production was t 251.57 million tons with a surplus of 19.29 million tons. However, India still lacks in production of pulses. In 2015–2016, production was16.35 tons against a requirement of 32.88 tons, which led to imports of pulses.

Table 2.1 Decennial trends of production of food grains in India (million tons)

Years	*Rice*	*Wheat*	*Coarse cereals*	*Total cereals*	*Pulses*	*Total food grains*
1950–1951	20.58	6.46	15.38	42.42	8.41	*50.83*
1960–1961	34.58	11.00	23.74	69.32	12.70	*82.02*
1970–1971	42.22	23.83	30.55	96.61	11.82	*108.43*
1980–1981	53.63	36.31	29.02	118.96	10.63	*129.59*
1990–1991	74.29	55.14	32.70	162.13	14.26	*176.39*
2000–2001	87.70	69.68	31.08	188.46	11.08	*199.54*
2010–2011	95.98	86.87	43.40	226.25	18.24	*244.49*
2015–2016	104.41	92.29	38.52	235.22	16.35	*251.57*

Source: *Handbook of Statistics in Indian Economy—Reserve Bank of India*, 2003 to 2016

policies at a macro level, widespread usage of HYVs, fertilizers, pesticides and irrigation and better access to credit, subsistence farmers at a micro level have started producing for the market, accounting for a large-scale marketable surplus.

If we consider commercial crops, the Indian agricultural sector has registered very high growth in cotton, sugarcane and rapeseed. In the case of sunflower, production increased from a mere 0.01 million tons in 1970–1971 to 13.79 million tons in 2016–2017, registering a more than thousand-fold increase in production. Table 2.2 presents production of major commercial crops.

It is evident from Table 2.2 that the Indian agricultural sector has registered high growth rates in major commercial crops. The following figure depicts the phenomenal rise in production of commercial crops in India. In the case of many crops, there has been acceleration in growth rates of total production. In the following section, we estimate the growth rates of all the crops for three periods: 1950–1951 to 1969–1970 before the Green Revolution; 1970–1971 to 1991–1992, the post-Green Revolution and pre-liberalization period; and 1991–1992 to 2015–2016, the post-liberalization era.

Determinants of Agricultural Productivity Growth

Indian agriculture in the late 1970s witnessed the phenomenon of the Green Revolution in which modern farm inputs were intensively used to increase productivity. However, in the initial phases, the Green Revolution was limited to only three or four states in India. Subsequently, other states caught up and productivity at all levels substantially increased. All the data

Table 2.2 Trends of production of commercial crops in India (in million tones)

Year	*Ground-nut*	*Rapeseed & mustard*	*Soybean*	*Coffee #*	*Cotton (lint)*	*Raw jute & mesta*	*Sugarcane*	*Tea #*	*Tobacco*
1950–1951	3.48	0.76	NA	NA	3.04	3.31	57.05	NA	0.26
1960–1961	4.81	1.35	NA	NA	5.60	5.26	110.00	NA	0.31
1970–1971	6.11	1.98	0.01	110.23	4.76	6.19	126.37	419.00	0.36
1980–1981	5.01	2.30	0.44	118.65	7.01	8.16	154.25	569.60	0.48
1990–1991	7.51	5.23	2.60	169.73	9.84	9.23	241.05	720.34	0.56
2000–2001	6.41	4.19	5.28	301.20	9.52	10.56	295.96	848.43	0.34
2010–2011	8.27	8.18	12.74	302.00	33.00	10.62	342.38	966.73	0.88
2016–2017	7.57	7.98	13.79	316.70	33.09	10.60	306.72	1250.49	NA

Tea and Coffee in millions of Kgs

Source: *Handbook of Statistics in Indian Economy—RBI*, 2003 to 2016

related to productivity, input usage, subsidies and Minimum Support Prices (MSP) are collected from secondary sources. For a couple of variables, like subsidy and MSP, continuous data are not available since 1950–1951, therefore we conducted an analysis between 1970–1971 and 2015–2016. In this section, we analyze the productivity growth in India for major crops for the period between 1970–1971 and 2015–2016.

The productivity function for all the crops can be specified as follows:

$$Y = f\left(F, I, S, M, T, Ut\right)$$

where,

Y is agricultural Output per hectare.

Fertilizer Consumption per hectare.

I is the proportion of area under Irrigation.

S is the total subsidies provided by the Union Government of India.

M is the MSP offered by the government for the surplus produce.

Ut represents all other factors affecting Yield.

For estimation of the yield function, we have specified the following double log-linear function:

$$\text{Ln}\, Y = \alpha + \beta_1 \text{Ln}\, F + \beta_2\, \text{Ln}\, I + \beta_3\, \text{Ln}\, S + \beta_4\, \text{Ln}\, M + Ut$$

Since rice accounts for the highest share of agricultural production in India, we analyze this crop in the present study. However, with availability of data for all the crops, the study can be extended to major food and commercial crops in India. The results of the factors determining rice productivity from the regression analysis are presented below.

Estimated Regression Equation for Rice:

$$\text{Ln}\, Y = 4.248 + 0.132\, \text{Ln}\, F + 0.566\, \text{Ln}\, I - 0.0302\, \text{Ln}\, S + 0.0605\, \text{Ln}\, M$$

SE	(0.7602)	(0.0793)	(0.2888)	(0.0227)	(0.0454)
t-Stat	(5.588)	(1.66)	(1.96)	(−1.32)	(1.33)

$R^2 = 0.97$, df = 41, Adj. $R^2 = 0.95$, F-Stat = 242.4

From the above regression result, it is evident that despite a high R^2 value, none of the explanatory variables are significant at 5 per cent level of significance. Subsequently, we have specified the model by removing the variable Gross Irrigated area and the revised model is specified as:

$$\text{Ln}\, Y = \alpha + \beta_1 \text{Ln}\, F + \beta_2\, \text{Ln}\, S + \beta_3\, \text{Ln}\, M + Ut$$

The estimated regression equation for the new model is:

$$\begin{array}{llll} \text{Ln Y} = 5.77 + 0.1811^{*}\,\text{Ln F} - 0.0116\,\text{Ln S} + 0.15009^{*}\,\text{Ln M} & & & \\ \text{SE} & (0.21799) & (0.0608) & (-0.44119)\ (0.03822) \\ \text{t-Stat} & (26.48) & (2.97) & (-0.441)\ (3.92) \end{array}$$

$R^2 = 0.97$, df = 42, Adj. $R^2 = 0.948$, F-Stat = 252.57

It is evident from the above regression model that both fertilizer consumption and MSP significantly influence productivity growth for the rice crop. From the log-linear model, we can conclude that a 1 per cent rise in fertilizer consumption will raise productivity by 0.18 per cent and a 1 per cent rise in MSP will increase productivity by 0.15 per cent. It may be noted that subsidies provided by the union government negatively influence productivity growth. However, the subsidy variable is not statistically significant. With a very high adjusted R^2 value of 0.948 and F-Statistic of 252.57, the overall robustness of the model explains the influence of explanatory variables to determine growth in rice productivity.

Challenges for Agricultural Sectors: Issues in Sustainability

The agricultural sector has come a long way since the independence era and boasts of ensuring food security for the country. However, if we compare the productivity of India's agricultural sector with that of developed nations like the United States and Japan, India is lagging far behind. The agricultural sector faces many challenges despite provision of huge subsidies and MSP and a positively interventionist policy approach by the government. Since the input market is highly regulated, the output prices do not keep pace with the rising levels of inflation and as a result, the farming sector's profitability is reduced to a significant extent. In addition, agricultural marketing infrastructure in India lacks farmer-friendly logistics and results in a huge difference in prices paid to the farmers and the prevailing market prices for agricultural products. Even though farm inputs are subsidized, agricultural labor poses a huge problem for farmers with rising wage rates and unavailability of seasonal farm laborers in rural India. Even though India's agricultural production and productivity growth has accelerated in in last four decades, sustaining the growth becomes challenging in the wake of rising wage rates and suppressed output prices for the farmers and lack of profitability in farming. Table 2.3 explains the

Table 2.3 MSP of food and commercial crops and rising inflation

Year	*MSP rice*	*MSP coarse cereals*	*MSP wheat*	*Pulses (gram)*	*Sugarcane*	*Groundnut*	*Sunflower*	*Soyabean*	*CPI-AL (1960–1961 base)*
1975–1976	74	74	105.00	90.00	8.5	140	150	NA	340
1980–1981	105	105	130.00	NA	13.00	206	183.00	198	395
1990–1991	205	180	225	450	22.00	580.00	600.00	400.00	803
2000–2001	510	445	610	1100	59.50	1220.00	1170.00	865.00	1744.6
2010–2011	1000	880	1170	2100	139.12	2300.00	2350.00	1440.00	2934.36
2015–2016	1410	1325	1525	3425	230.00	4030.00	3800.00	2600.00	4576

Source: *Handbook of Statistics in Indian Economy—RBI*

gap in rising wages and inflation levels and rise in agricultural output prices in India over the last four decades. The CPI has been used for agricultural laborers to represent rising wage rates and the inflation levels in the economy. The MSP of various food and commercial crops are considered since data on market prices on all crops vary and are not available from secondary sources for the time period considered.

It is evident from Table 2.3 that the output prices in the agricultural sector have not kept pace with the rising price levels and hence profitability is compromised for the farming sector. We argue that if the agricultural sector is freed from interventional policies, then equilibrium market prices will help farm profitability, which would attract private investments and entrepreneurship. This way, the Indian agricultural sector can sustain its high growth rates in production and productivity and will ensure food security of the country in the coming years.

Conclusions

This chapter attempted to analyze the trends in production and productivity of the Indian agricultural sector. The study finds that there has been acceleration in growth of agricultural production. Among food grains, cereals have registered very high growth rates since the 1970s though the growth in production of pulses has not been impressive. Among commercial crops, sunflower stands out with an impressive 118 times the production levels of 1970. Also, other commercial crops like groundnut, cotton, jute, rapeseed and mustard have been very impressive. The high levels of production could be achieved due to high productivity growth. The study finds that usage of fertilizers and provision of MSP significantly contributes to productivity growth with a 5 per cent level of statistical significance. The study also finds that though not statistically significant, subsidies negatively influence the productivity growth of the rice crop in India. The study finds that the agricultural sector faces various challenges to sustain its high levels of production and productivity growth. The regulated market prices and lack of marketing infrastructure make the farming sector unprofitable and hence unattractive to private investment and innovative entrepreneurship. The present study argues that government intervention should be aimed at providing better prices to the farmers and providing marketing infrastructure to boost the profitability of India's agricultural sector.

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