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What ails Indian Agriculture?
Policy Reforms for a second Green Revolution

Ashok Gulati
Kavery Ganguly

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Ashok Gulati and Kavery Ganguly
International Food Policy Research Institute
New Delhi Office

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What Ails Indian Agriculture?
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Ashok Gulati & Kavery Ganguly

1.Introduction

While India’s overall growth story remains a resounding success with its GDP growth hovering around 8.5% in the last five years (2005/06 to 2009/10) despite recessionary trends in the global economy, its agriculture has been underperforming with a growth rate of around 3% per annum (during 2005/06 to 2009/10) and that too with high volatility. This is way below the target rate of growth of 4% per annum during the last (2002-07) and the current (2007-12) Five Year Plans. Within Indian agriculture’s landscape, there are pockets of crisis (as in Vidharbha region of Maharashtra where number of farmers committed suicides), but there are also several bright spots where agriculture has been doing quite well (like in Gujarat) for a number of years since 2001. However, what matters is whether Indian agriculture as a whole is able to deliver sustained levels of high growth (at least above 4% per annum) that can ensure food security of a large and growing population, lift millions of poor dependent on agriculture out of poverty, and improve their nutritional status. That’s what has not happened at a pace one would have desired. And it is in this very context, that the papers first reviews the growth experience in agriculture since economic reforms started (section II), tries to diagnose the reasons behind why the growth in agriculture has lagged behind (section III), put forth an agenda for agriculture policy reforms (section IV) that can not only usher in a second green revolution in Indian agriculture and ensure its food security, but also put it on a higher growth trajectory that will reduce poverty much faster than has been the case since the beginning of economic reforms, and also help improve the nutrition status of the people of India. Section V summarizes the discussion.

It may however be noted that agriculture is still a very important sector in India. Its significance is not just that it contributes 17% of the total GDP or engages 52% of the Indian workforce, but the fact that an average Indian household spends almost half of its expenditure on food. And to that extent, the larger goals of food and nutrition security, poverty alleviation, and other human development goals are closely linked with the performance of the agricultural sector (World Bank 2008). The World Development Report 2008 based on the growth experience of several developing countries during the

1 Ashok Gulati is Director in Asia and Kavery Ganguly a Senior Research Analyst at IFPRI New Delhi Office.
last 25 years or so, clearly stated that one percentage growth in agri-GDP is at least two to three times more effective in alleviating poverty than the same growth coming from non-agri sectors. It has also been clearly envisaged in several policy dialogues and documents of the GoI (Planning Commission 2010) that a higher and sustainable growth in agriculture is essential for faster reduction in poverty and malnutrition, and to give a fillip to overall economic growth by creating demand at the bottom of the economic pyramid.
2. Agricultural performance (1980-81 to 2009-10)

2.1. All India and state level performance

Agricultural performance in India has been highly volatile and less than the desired rate of growth of 4% in the last and current five year plans (2002-2007 and 2007-2012). The trend rate of growth has been nearly 3% between 1980/81 to 2009/10 (figure 1a). While the trend growth rate exhibits very little fluctuation during the three decades, the average annual growth rates reflect some differences due to high volatility (figure 1b). Hence it is important to keep in mind the kind of measure used to interpret agricultural growth rates.

Figure 1: Agricultural Performance: 1980/81 to 2009/10 (a) trend rate of growth (b) annual growth rate

Source: Agricultural GDP from National Accounts Statistics (NAS), various issues, Central Statistical Organization (CSO), Government of India (GoI) various issues.

It is also observed that the trend growth rate has been broadly same during the three decades of 1980s, 1990s, and 2000s. However it is observed that the annual average agricultural growth rate has come down systematically over the same period under consideration (table 1).

Table 1: Agricultural growth over the past three decades: 1980s, 1990s, and 2000s

<table>
<thead>
<tr>
<th>Period</th>
<th>average annual growth (%)</th>
<th>Trend growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980/81-1989/90</td>
<td>4.4</td>
<td>2.9</td>
</tr>
<tr>
<td>1990/91-1999/2000</td>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td>2000/01-2009/10</td>
<td>2.4</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Source: Agricultural GDP from National Accounts Statistics (NAS), various issues, Central Statistical Organization (CSO), Government of India (GoI).
Agricultural performance at the state level is quite heterogeneous and the extent of volatility varies across states. For the latest decade of 2000s, depending upon the years for which state level data is available, it is interesting to see that a state like Gujarat is the front runner, growing at the rate of 10.2% during 2000/01 to 2007/08 (for which the latest data is available from CSO), while other agriculturally important states like Uttar Pradesh and West Bengal are growing at 2.2% and 2.4% respectively during 2000/01 to 2008/09. It is not enough to consider the growth rates but also look at the degree of volatility which measures the sustainability of the growth process. As observed at the all India level, agricultural growth is also extremely volatile at the state level (figure 2a).

Figure 2: State-wise agricultural performance: (a) (% change in agri-GDP): 2000/01 t0 2009/10. (b) % share in total agri-GDP: TE 2007/08

States like Chattisgarh, Rajasthan, Himachal Pradesh, and Bihar which have been growing at 5% and above during 2000/01 to 2009/10 and account for 13% of agricultural GDP (TE 2007/08), exhibit high volatility as observed from high coefficient of variation ratios. Also, some of the poor performing states like Madhya Pradesh, Jharkhand, Tamil Nadu and Kerala are extremely volatile and these states together account for 13.6% of agricultural GDP (TE 2007/08). The top five states in terms of agricultural growth account for 18% of agricultural GDP (figure 2b).

2.2. High volatility in agricultural growth

A distinguishing characteristic of the growth story of Indian agriculture is its high volatility emanating from its high dependence on monsoons. Invariably, the years of low growth rate in agriculture are the ones facing severe droughts, and high growth rate years either follow the dip of droughts or they are the

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2 Data after 2007/08 not available for Gujarat and that of Uttar Pradesh and West Bengal not available after 2008/09.
good monsoon years. For instance, 2002/03 was a year of severe drought, with 61% of the Indian districts having received deficient/scanty rainfall, and growth rate plummeted to (-) 7.2%. In the following year, 2003/04, the growth rate jumped to 10%. However it is interesting to note that of late, the agricultural sector seems to be acquiring some amount of resilience. For example, 2009/10 being the worst drought year since 1972, yet the growth rate declined to only 0.2% only (figure 3). Whether this is because of increasing investments in irrigation or just that the pattern of rainfall was such that it did not hit the overall agricultural performance, needs to be examined in depth. The gross irrigated area as a percent of gross cropped area has increased from 34% in 1989 to 44.3% in 2007.

However, it is true that the volatility in agricultural growth rates is even higher at state level (figure 2a), especially in those states that have large areas under rainfed agriculture. A state like Punjab, with highest irrigation coverage of cropped area, has the lowest coefficient of variation (CV less than 1) of state agricultural GDP, while a state like Karnataka with heavy dependence on monsoon has CV of more than 40 (figure 2a) during the decade of 2000s.

Figure 3: Departure of actual from normal rainfall, agricultural performance and gross irrigated area as a percent of gross cropped area: 1989 to 2009

There are concerns about the increasing incidence of floods and droughts indicating the severity of climate change impact and the agricultural sector likely to face the aftermath (Nelson et.al. 2009, FAO-Gol 2009).
2.3. Changing production basket: a demand pull effect

Indian agriculture is increasingly diversifying from traditional crops to high value commodities which comprise of fruit and vegetables, livestock products, and fisheries. The share of high value commodities has increased from 40.6% in TE 1992/93 to 48.4% in TE 2008/09 (figure 4). Food grains account for less than 25% of the value of output in TE 2008/09 yet continue to dominate the policy debates presumably due to food security reasons.

**Figure 4: Percentage distribution of value of output of agriculture, livestock, and fisheries in India: TE1992/93 and TE2008/09**

<table>
<thead>
<tr>
<th></th>
<th>TE1992/93</th>
<th>TE2008/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>26.8</td>
<td>20.9</td>
</tr>
<tr>
<td>Livestock</td>
<td>23.5</td>
<td>17.4</td>
</tr>
<tr>
<td>F&amp;V</td>
<td>13.4</td>
<td>13.3</td>
</tr>
<tr>
<td>Pulses</td>
<td>4.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>6.7</td>
<td>6.8</td>
</tr>
<tr>
<td>Sugars</td>
<td>3.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Fibres</td>
<td>2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Other crops</td>
<td>15.8</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Source: National Accounts Statistics (NAS), various issues, Central Statistical Organization (CSO), Government of India (GoI) various issues.

The state level data for value of output is available until 2005/06 only and looking at the geographical dimensions, it is observed that most of the eastern states are agriculturally more diversified. More than 60% of the value of output of agriculture comprise of high value commodities for states like West Bengal, Jharkhand and Bihar but less than 40% for states like Punjab, Haryana, UP, Rajasthan and MP (figure 5). Many of these states are the ones which experienced green revolution and are now finding it difficult to diversify to high value agriculture as all incentives and institutions are geared towards grains.
Figure 5: Percent share of high value agriculture in total agriculture (crop, livestock & fisheries) by states: annual average of 2000/01 to 2005/06

![Graph showing percent share of high value agriculture in total agriculture by states.]


The pressure on natural resources particularly groundwater is alarming in these states and also the environmental stress is increasing. Perhaps these are the states which should have diversified much more and the grain basket, especially rice should have moved to the eastern region as a part of second green revolution, which is today overdue.

While the physical volumes have increased manifold over the years, the performance has been quite volatile. Also, post harvest wastage continues to be an issue, and value addition is poor owing to fragmented supply chains and lack of quality produce. The future growth in agriculture is likely to come increasingly from the high value sector and that from traditional grain crop sector will be limited. According to the fourth advance estimates for 2009/10, overall food grain production has declined by about 16.3 million tonnes, although production of pulses has increased marginally (GoI 2010). This is largely due to the severe drought in 2009 which had an adverse impact on the kharif output.

Figure 6: (a) Average annual growth of value of output of agricultural commodities at 2004/05 constant prices: 2005/06 to 2008/09

![Graph showing average annual growth of value of output of agricultural commodities.]

In terms of value of output, it is observed that between 2005/06 to 2008/09, high value commodities have grown faster than food grain crops except the milk group (at 3.7%) (figure 6).

The diversifying trends in Indian agriculture is indicative of the change in demand patterns, wherein people are moving from traditional cereal based dietary patterns to more of high value, protein rich food. This also marks a need to shift the policy approach toward agriculture; from supply push to demand pull.

2.4. Thali (plate) driving the plough: consumption shifts trigger change towards high value agriculture

Consumption of cereals has declined over time: per capita monthly consumption of cereals has come down from nearly 15 kg in 1983 to 12 kg in 2004/05 and 11.7 kg in 2007/08 in rural areas while that in urban areas it has declined from 11.3 kg in 1983 to almost 10 kg in 2004/05 and 9.7 kg in 2007/08 (NSSO various years). Food expenditure accounts for more than 50% of the monthly per capita expenditure and more than 60% for low income groups in India. Although the share has declined over a period of time, that of high value commodities in food both in urban and rural India has increased (table 2).

Table 2: Changing complexion of the Indian food basket

<table>
<thead>
<tr>
<th>Items</th>
<th>Expenditure as percent of total food</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals and pulses</td>
<td>55.3</td>
<td>38.7</td>
<td>38.6</td>
</tr>
<tr>
<td>Milk &amp; products</td>
<td>11.5</td>
<td>15.4</td>
<td>15.7</td>
</tr>
<tr>
<td>Egg, fish &amp; meat</td>
<td>4.6</td>
<td>6.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Vegetables</td>
<td>7.2</td>
<td>11.1</td>
<td>8.4</td>
</tr>
<tr>
<td>Fruits &amp; nuts</td>
<td>2.1</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Other food items</td>
<td>19.3</td>
<td>25.4</td>
<td>27.6</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Percent of total expenditure spent on food</td>
<td>65.6</td>
<td>55.0</td>
<td>59.1</td>
</tr>
</tbody>
</table>

Source: NSSO, CSO, GoI 2006.

The changing consumption patterns from low value cereals to high value cereals and processed varieties are being driven by higher economic growth, rising trends in urbanization, increasing number of women professionals, and higher expenditure elasticity for high value products, etc. In effect, it has been observed that income structures are changing and this has given birth to a rising middle class in India.
driving demand in India. With fairly young population, India is in a position to benefit from the demographic dividend. Based on major surveys of NCAER at different points of time, Shukla 2010 reports that while the high and middle income households have been rising since 1985/86, the low income households have been declining 1993/94 onward. It is interesting to observe that the number of low income (annual household income of less than Rs 45,000 at 2001/02 prices) has declined from nearly 84 million (or 65.2% of total households) in 1985/86 to 41 million in 2009/10, accounting for 18% of the total number of households (figure 7).

Interestingly, this data collected through a survey of 440,000 households on more frequent basis than NSSO, shows much faster decline in low income households than the NSSO data for poor households based on expenditure patterns. It deserves some further study. The rate of decline (percentage of low income households moving out of low income category annually) is much higher in the post reform period, especially 1993/94 to 2001/02 and then again between 2001/02 to 2009/10. While the number of poor households declined by 1% annually during 1985/86 to 1993/94, the period onward until 2001/02 witnessed a annual decline of 3.5% and between 2001/02 and 2009/10, it declined by 4.6%.

A double dividend is observed in terms of a rising middle class and declining low income class. Mckinsey 2007 projected that the rising consumerism in India will be primarily driven by rising income levels, population growth and gradual plateauing of the savings rate. About 80% of the consumption boom is likely to come from rising income levels. Increase in the disposable income with people will result in emergence of a powerful middle class, taking India from the world’s twelfth largest consumer market to the fifth largest by 2025.\(^3\) However India is still home to a large number of poor people. Although their

\(^3\) Also, quite unique to India is a strong rural sector which accounts for 70% of the total population, 56% of national income, 64% of total expenditure and 33% of savings. It has also undergone a major transformation in terms of rising share of non-farm
share in the total population has declined over time from 38.8% in 1987/88 to 27.5% in 2004/05 as per NSSO data (there are wide ranging debates on the actual poverty count in India)\(^4\), more than 300 million people continue to live below the poverty line. Ensuring their food and nutrition security remains a challenge.

2.5. Recent big bangs in Indian agriculture: case of Bt cotton and hybrid maize

While in the past, Indian agriculture had witnessed at least two revolutions, the green revolution in wheat and rice in the late 1960s and 1970s, and the while revolution in milk in late 1970s and 1980s, the decade of 2000s would be remembered by what happened to production of cotton and maize. Both have seen dramatic changes. Cotton production has doubled while maize production went up by more than 60% (figure 8).

![Figure 8: Yields of cotton and maize: all India, 1990/91 to 2008/09](image)


Both seem to have been triggered by infusion of new technology, Bt in case of cotton and hybrids in case of maize, and interestingly both these technologies came primarily through the private sector.

In case of Bt cotton, it all started in 1995, when Mahyco obtained the permission to import 100 grams of Coker 132 variety seed from Monsanto (Barwale 2010). It took long periods of trial and demonstration to ensure that it adheres to the legal requirements of food and environmental safety standards. Finally,
it was only in 2002 that the Genetic Engineering Approval Committee (GEAC) approved the commercial release of Bollgard-I variety, although the seeds had already found their way to the farmers’ field in Gujarat in 2001. The number of Bt cotton hybrids and the companies offering these increased dramatically during the eight year span from 3 hybrids and 1 company in 2002 to 522 hybrids and 35 companies in 2009. Of the total 35 companies, only one is a public sector institution from India and the rest 34 are indigenous seed companies (James 2009).

Rapid adoption by Indian farmers over the past eight years resulted in India becoming the largest cotton exporter and second largest producer of cotton (292 million bales in 2009/10). Cotton sector has definitely benefited from increased productivity (302 kg/ha to 554 kg/ha in 2002/03 and 2007/08 respectively), and increased export opportunities (83,000 bales in 2002/03 to 8.5 million bales in 2007/08) overtaking USA in 2006/07. In 2009, about 49% of the global area under cotton was under Bt varieties and about 87% (8.4 million hectares) of the same in India up from 50,000 hectares in 2002. Between 2004 and 2006, area under Bt cotton tripled from 1.3 million hectares to 3.8 million hectares. Bt cotton in India has been widely adopted by farmers increasing from 50,000 in 2002 to 5.6 million in 2009. More than 80% of the 5.6 million cotton growers in India are small and resource poor in nature (Ibid). Based on a meta-analysis of the existing studies on the impact of Bt cotton in India, it is observed that Bt cotton reduces the number of pesticide sprays by 32%–40%, reduces pesticide costs by 30%–52%, increases the total cost of production by about 15%, has no clear effect on seed cotton prices, increases yields by 34%–42%, and raises net returns by 52%–71% (Gruere, Mehta-Bhatt, and Sengupta 2008).

The adoption of Bt cotton in India was not smooth. There was fierce opposition from various quarters that it would aggravate the plight of cotton growers. Cotton in India has been associated with farmer suicides for long but perhaps it has little to do with the seed per se and more with other institutional factors such as pest management system, irrigation and also the credit system. Cotton is grown predominantly in 9 Indian states; with 71% of the production coming from Gujarat, Maharashtra and Andhra Pradesh. While more than 44% of the cotton area in Gujarat is irrigated, and 21.3% in Andhra Pradesh, as little as 3.3% of the area in Maharashtra is irrigated. Biotech crops in general are widely adopted by small and resource poor farmers across the world. There is a need to strengthen other institutional arrangements to ensure that the process is sustainable and also the risk mitigation measures are in place.
Similar revolutions are possible in other crops and the potential in food crops (vegetables or cereal crops) is quite high in India. Genetically modified (GM) technology can serve as a boon to address the food security concerns of India and there is need to render the process of approval, adoption, and pricing of seeds more transparent and research based.

Maize has been quite successful in India in the recent past; production of maize increased from 12 million tonnes in 2000/01 to 19.7 million tonnes in 2008/09 and area from 6.6 million hectares to 8.2 million hectares during the same period. In a single year, 2007/08 over 2006/07, production and yield of maize increased by 25.6% and 22.2% respectively.

The maize revolution in India is largely ascribed to the hybrid variety. Nearly 55% of the maize seed used in India are of hybrid variety (NSAI 2009). Maize has been particularly quite successful in Bihar. The productivity of winter (rabi) maize which accounts for 32% of the area under maize in the state is about 4 tonnes per hectare compared to 2.5 tonnes per hectare at the all India level. Between 2000/01 and 2007/08, area, production and yield of winter maize grew at the rate of 1.8%, 8.7%, and 6.5% respectively. Recurrent floods are cited as a reason for farmers investing in rabi crops rather than kharif and winter maize is one of the options. The seed replacement rate in Bihar has increased from 21% in 2000/01 to 80% in 2007/08. There are several private sector companies who are engaged in hybrid seed business and have been supplying the seeds to the farmers (IFPRI 2010). Nearly 63% of the demand for maize in India comprises of feed which is largely attributed to the growing poultry market. The potential yields of winter maize are about 6 to 8 tonnes per hectare and there is considerable scope for improving the productivity of maize in India. Similar breakthrough in hybrid rice would be welcome in the context of the second green revolution that is being championed by the government of India.

2.6. Has slower performance in agriculture led to huge imports of agricultural commodities in India?

It is interesting to observe that despite somewhat slower growth in Indian agriculture (about 3%) compared to its targeted growth of 4%, and ever growing population, India has still been a net exporter of agricultural produce.

Net agricultural exports have increased from USD 2.7 billion in 1990/91 to USD 10.7 billion in 2008/09 (figure 9a). Also, agricultural exports account for 9.7% of agricultural GDP and imports 4.1% of the same in TE 2008/09. India exported about USD 2.4 billion worth of rice, USD 0.6 billion worth of cotton and
USD 1.4 billion worth of fresh and processed fruit and vegetables, and USD 1.5 billion of marine items in 2008/09 (figure 9b).

Figure 9: (a) Net agricultural exports: 1990/91 to 2008/09. (b) Export of key agricultural commodities: 2000/01, 2007/08 and 2008/09

It is also interesting to note, especially for those concerned with India’s food security (basically staples), that during the period of 2000s (2001/02 to 2008/09) India has exported (net) cereals to the tune of 49 million tonnes; 33.2 million tonnes of rice, 5.3 million tonnes of wheat, and remaining 10.5 million tonnes of other cereals (Gol 2009). And currently in 2010, as India is continuing its ban on exports of wheat and common rice, it has accumulated reserves of more than 50 million tonnes, almost 100% more than its buffer stock norms (more in section 4).

India’s status of remaining net exporter of agriculture is in fact commendable if one views the inherent bias in trade and exchange rate policies that discriminated against agriculture all through 1970s to 1990. It is well known that during much of 1970 to 1990, agriculture was discriminated against relative to the manufacturing sector owing to high levels of protection accorded to the latter and also an overvalued exchange rate. Devaluation of the rupee, along with reduction in tariffs for manufacturing were bold reforms undertaken in 1991 which helped correct the relative dis-protection of the agricultural sector (Pursell, Gulati and Gupta 2009). India is export competitive in most of the agricultural staples and cash crops. Sugar and dairy products are potential sectors provided the existing distortions in global markets are corrected (Hoda and Gulati 2008).
3. Why the growth has been slow? Diagnostics of what ails Indian agriculture and what can be done about it:

What really ails Indian agriculture, as documented and debated are inadequate investments in agriculture. Public sector investments in agricultural R&D have been hovering between 0.4% to 0.6% of agricultural GDP, while developing countries like Brazil is spending more than 1% of agri-GDP. Irrigation and power still suffer from deficiency of adequate investments and poor governance, and so is the case of rural roads and agricultural markets. These are the areas where public sector has to play a key role. But government resources into agriculture are being increasingly channeled through subsidies (food and fertilizer in particular), crowding out public investments in agriculture, resulting in stagnating productivity and low growth. Private investments in value addition along the supply chain are also lacking partly because of archaic laws pertaining to storage limits, future markets, warehouse receipt systems, or controls on FDI for organized retail etc. In other words, lack of investments, effective incentives and appropriate institutions are not able to deliver higher agricultural growth. Studies have clearly revealed that the returns to investment are much higher than those to subsidies and hence there is a need for augmenting investible resources through rationalization of subsidies (Fan, Gulati and Thorat 2009). This also requires reforming the existing incentives and institutions to ensure effective delivery of services and better utilization of resources. While the gross capital formation in agriculture has increased from 8.5% of the agricultural GDP in TE 1982/83 to 16.6% of the same in TE 2008/09, share of public sector in gross capital formation in agriculture has declined from 46.4% to 21.3% during the same period.

Several studies in the past have tried to explain the reasons behind slower agricultural performance in India. Chand, Raju and Pandey 2007 highlighted factors such as decline in cultivated area, deterioration in agriculture terms of trade, stagnant crop intensity, poor progress of irrigation and fertilizer, decline in supply of electricity to agriculture and slow down in diversification to have resulted in a slowdown in agriculture at national level after 1996/97. According to Sahu and Rajasekhar 2005 availability of credit to the priority sector at concessional interest rates is most important factor behind agricultural growth. Dhar and Kallummal 2004 cited declining share of agriculture in gross capital formation as a reason for slow agricultural growth during 1990s. Landes and Gulati 2004 suggested various reasons ranging from the declining trend in public sector investments in agriculture to adverse impact of trade liberalization resulting from the collapse in world prices of major agriculture products during 1997 through 2003. Dev 2002 put forth that there is a greater need for public investment in agriculture, irrigation, credit availability, better marketing of agricultural products, R&D along with adequate pricing and other
incentives for private investment that would help revive agricultural growth. Gulati and Bathla 2002 considered public sector investment as an important source of growth in agriculture.

Some of these arguments are discussed in greater detail below.

3.1. Role of investments and subsidies in agriculture

The existing level, structure and delivery mechanism of agricultural subsidies (both input and output) have outlived their significance and it is time to rationalize the same and enhance agricultural investments. Food, fertilizer, power and irrigation subsidies together account for 15.1% of agricultural GDP in TE 2009/10 up from 7.8% of the same in TE 1995/96. Food and fertilizer subsidies account for the larger share of agricultural subsidies and its share peaked to 74.3% in 2008/09, when world prices of food and fertilizers peaked (figure 10).

![Figure 10: Percentage distribution of agricultural subsidies in India: 2000/01 to 2009/10](image)


Note: Data on power and irrigation subsidies available up to 2007/08.

The fertilizer subsidy bill of Rs 766 billion (or approximately USD 16 billion) in 2008/09 was a result of high global prices of fertilizer during that year and the government’s effort not to pass on the price burden to the Indian farmers. The efficacy of these subsidies have been questioned in the context of who benefits and at what cost. Gulati and Narayanan 2003 showed that the farmers’ share in fertilizer subsidy was 67.5% during the period of 1981/82 to 2000/01, the rest going to the fertilizer industry. It has often been cited that most of the subsidies tend to benefit large farmers and it is recommended to replace the system with direct transfer of subsidies to farmers in the form of direct cash transfers or coupon system. Also, increasing fertilizer subsidies have resulted in distortions in the NPK ratio and therefore introducing nutrient based subsidies can help correct it.
Coming to food subsidies, the gap between issue prices and economic cost of rice and wheat has resulted in burgeoning food subsidy bill. The minimum support price for key agricultural commodities has also increased over a period of time and peaked in 2008/09. The rationale of continuing with the public distribution system and the Food Corporation of India as the apex institution is well debated in the country. Problems with the endowments reaching the beneficiaries such as poor targeting, leakages, etc are often cited. It has been recommended to replace the system with direct cash transfer or food coupons. The recent Food Security Bill aims at providing further subsidized food to the poor and there are appeals for universalization of Right to Food. The year 2008/09 witnessed a sharp rise in subsidies in the form of rise in minimum support prices, fertilizer subsidies, and farmers’ loan waiver. Although very populist in nature these lack much economic rationale.

Looking at the 2010/11 central outlay, it is observed that a significant part of the resources are channeled in the form of subsidies (USD 22 billion of food and fertilizer subsidies), no wonder why resources are not able to steer on to a higher agricultural growth trajectory (table 3).

<table>
<thead>
<tr>
<th>Table 3: Selected central outlay in India: 2010/11</th>
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<tbody>
<tr>
<td>Items</td>
</tr>
<tr>
<td>I. Agriculture</td>
</tr>
<tr>
<td>Department of Agriculture &amp; Cooperation (NFSM, NHM, MI, MMA, NAIS, etc)</td>
</tr>
<tr>
<td>Department of Agriculture Research &amp; Education (including NAIP)</td>
</tr>
<tr>
<td>Animal Husbandry, Dairying &amp; Fisheries</td>
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<tr>
<td>II. RKVY (National Agricultural Development Program)</td>
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<tr>
<td>III. Accelerated Irrigation Benefit Program</td>
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<tr>
<td>IV. Rural Development (NREGA, SGSY, Rural Housing, PMGSY)</td>
</tr>
<tr>
<td>Mahatma Gandhi National Rural Employment Guarantee Act (NREGA)</td>
</tr>
<tr>
<td>Swaranjayanti Gram Swarozgar Yojana (SGSY)</td>
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<tr>
<td>Rural Housing</td>
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<tr>
<td>Pradhan Mantri Gram Sadak Yojana (PMGSY)</td>
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<tr>
<td>V. Major Subsidies (food &amp; fertilizers)</td>
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</tbody>
</table>


Total public sector allocation (centre, states, and UTs) to agriculture has declined over the plan period from 14.7% in the fourth plan period (1969-74) to 3.7% in the eleventh plan period (2007-12) (Gol 2010).
Public sector outlays in irrigation as a percent of total plan outlays has declined from 23% in the first plan period (1951-56) to 6.8% in the tenth plan period (2002-2007). The projected figures for the eleventh plan at 2006/07 prices is 5.8% (Ibid.). However, absolute fund allocation has increased over time, a major share going into development of major and medium irrigation projects.

3.2. Gross capital formation in agriculture

Agricultural investments are critical for growth of the sector and hence it is important to understand if the current levels and nature of investments are adequate enough to deliver higher agricultural growth. There are some observable trends in gross capital formation as given by the Central Statistical Organization (CSO). While the share of gross capital formation in agriculture (GCFA) as a percent of agricultural GDP has increased over the past two decades (from 8.5% in TE 1982/83 to 16.6% in TE 2008/09), it is an observed fact that the share of GCFA in GCF has declined over the same period from 17.1% in TE 1982/83 to 7.7% in TE 2008/09 (figure 11). On the other hand, GCFA from the private sector comprising of household and corporate sectors has increased and account for nearly 79% in TE 2008/09. This is in line with the trends in overall GCF in India. Also, a faster decline in GCFA as a percent of overall GCF compared to its decline as a share of overall GDP over time is indicative of a “relative neglect” of agriculture (Gulati and Bathla 2002). The complementarily between public and private sector GCFA has been studied in the past. Chand and Kumar 2004 observed that there exists an asymmetry in the relationship; when public GCFA increases, it induces an increase in private GCFA but the converse is not true. Often declining public GCFA is compensated by an increasing private GCFA, flowing largely from the household (farmer) sector. They also studied that the effect of public sector GCFA on private sector GCFA was highly non-significant. The rate of return on private investments (determined by terms of trade and technology) was observed to be the most significant determinant of private GCFA.

Figure 11: Gross capital formation in agriculture and terms of trade in India: 1980/81 to 2008/09

Terms of trade (TOT) are an important determinant of investments in agriculture. Investments depend not just on the returns from the sector but also on the profitability relative to other sectors. TOT of agriculture relative to non-agricultural sector improved in the post liberalization period. This was accompanied by increasing private investments although public sector investments declined over a period of time.
4. An Agenda for reforms towards ushering in a second green revolution in India

4.1. A second green revolution: opportunities and challenges

Food security continues to be a concern in India and the issues of availability, accessibility, and absorption are high on the policy agenda. The focus has been on ensuring adequate production of food grain to address the issue of availability. Rather there is an over-emphasis on enhancing food grain production and the approach is questionable given the changing dietary patterns in India. While there is a concern about stagnating grain yields which threaten grain availability, it should be noted that there have been years when India accumulated large stocks of rice and wheat (figure 11). Stocks of rice and wheat touched a peak of 63 million tonnes in July 2002, which were then disposed using an export subsidy. Again in the recent past, stocks piled up to nearly 58 million tonnes as against a buffer norm of 26.9 million tonnes in July 2010 (figure 12). The recent food crisis in 2008-2009 prompted the Indian government to impose bans on wheat and rice (common variety) exports to ensure domestic availability and also restrict flaring up of domestic prices. Large stocks helped make up for the lower kharif output in 2009/10 owing to the severe drought situation in 2009. Even then there are excess stocks and therefore it is pertinent to question how much stocks should be held to meet the requirements of the public distribution system and other unforeseen demands.

Figure 12: Buffer stocks (actual and norms) of rice and wheat in India: 1992/93 to 2010/11


Fluctuating production, large stocks of grain do not explain inadequate accessibility and poor absorption conditions. The need for a second green revolution is well recognized and efforts to launch it are underway. The question is whether the existing incentives and institutions in a business-as-usual framework are enough or there is a need to revamp the existing system. The issue of sustainable
production systems has also surfaced given the rising stress on natural resources particularly groundwater and environmental conditions.

Northern states like Punjab, Haryana, and parts of Uttar Pradesh have been the grain basket of the country. About 26.6% of rice and 36.4% of wheat production emanate from these states together (TE 2007/08). This is supported by a strong procurement network; Punjab and Haryana account for 65.7% and 28.3% of wheat procurement respectively (TE 2008/09) and Punjab alone accounts for 28% of rice procurement (TE 2008/09). West Bengal which accounts for 16.4% of all India rice production accounts for 4.2% of total procurement (figure 13). Procurement from Bihar or Assam is very minimal while Orissa accounts for 8.2% of the total procurement.

**Figure 13: Production and procurement of rice by states: TE 2008/09**

The northern states have better incentives to produce rice and wheat compared to the eastern states in terms of support prices (although applicable to all states) and assured procurement. However it is quite evident that production of rice in particular in the northern states is not sustainable. The stress on groundwater owing to rice-wheat cycle is most severe in the northern region and has reached an alarming situation. Diversifying towards high value commodities which are less water intensive and environmentally more benign have been recommended.

The second green revolution can be ushered in the eastern part of India, which is water abundant, and lower yield provides an opportunity to expand further. States like Orissa, Assam, and Bihar have lower yields, at less than 2 tonnes per hectare and hence have the potential to expand further (figure 14a). Unlike Bihar, per hectare use of fertilizer is low in Assam and Orissa at 55 kg/ha (TE 2007/08). Compared to states like Punjab (209 kg/ha) and Andhra Pradesh (192 kg/ha) which already have a very
high fertilizer use, the eastern states have relatively lower fertilizer use and hence there is a possibility to boost productivity through increased use of fertilizers without distorting the ratio of NPK.

Figure 14: (a) Rice yield and fertilizer use per hectare by states: TE 2008/09 (b) average annual change in rice yield (%): 2004/05 to 2008/09

It is also observed that over the past five years (2004/05 to 2008/09), rice yields have been quite fluctuating across states, particularly in the case of Bihar and Jharkhand (figure 14b).

While there are opportunities of shifting the bread basket to this region, there are certain institutional challenges that need to be overcome. Enhancing grain production in the region will require bringing in a technological breakthrough to improve productivity, developing markets and rural infrastructure. The government has already sanctioned a sum of Rs 4 billion (approximately USD 83 million) as one of the components of the larger program of Rashtriya Krishi Vikas Yojana (RKVY) in taking the green revolution to the eastern region. There are also thoughts on accelerating the adoption of hybrid rice as part of this new initiative. Area under hybrid rice is about 3% only and there are opportunities of further expansion.

In this context, there are some key lessons that the elephant can learn from the dragon, where at present more than 60% of the area is under hybrid rice. The newer initiatives maybe dovetailed with the existing National Food Security Mission (NFSM) which also focuses on increasing production of rice, wheat and pulses through increase in productivity. Since the private sector already has a strong presence in the seed market, there could be opportunities for greater partnerships in this new venture.
4.2. Changing leadership: public versus private sector participation

Nearly all segments of Indian agriculture have been by and large dominated by the public sector, from procurement to pricing and trading of food items. At times public sector support in the form of protection and subsidies have crowded out other sector participation. Although agriculture was liberalized to a large extent post the economic liberalization in 1991, the approach has been rather piecemeal. However looking back into the evolution of Indian agriculture, it is well observed that the major breakthroughs or revolutions have been the result of vibrant partnerships; between public, private or international agencies. While the popular Green Revolution was largely driven by the public sector, it was in collaboration with CGIAR network. During Operation Flood, the government played a more supportive role in terms of channeling funds from international agencies and was driven more by private entrepreneurship. The recent revolutions in agriculture; Bt cotton, hybrid maize or horticulture, private sector has emerged as an important player. Looking at the type and volume of investments that would be needed in agriculture, it is most likely to come from the private sector with the public sector providing the right incentives and environment. This changing leadership from public sector to private entrepreneurship has also marked a shift from “not-for-profit” to “for-profit” approach.

To cite an example, Monsanto, one of the leading agricultural companies spends a considerable part of its sales in investments in R&D. In 2009, it posted net sales of $11.7 billion and invested nearly $ 1.1 billion in R&D in 2009, accounting for 9.4% of their net sales (Monsanto 2009). This is perhaps the largest private sector expenditure in R&D. Compared to other leading market players such as DuPont, BASF, and others; Monsanto records the highest expenditure on seeds/traits (figure 15a). This is in contrast to the declining support for agricultural R&D and infrastructure development by international agencies such as the World Bank, Asian Development Bank and hence that of the Consultative Group of International Agricultural Research (Zeigler & Mohanty 2010). As for the CGIAR, the funding has increased in nominal terms but remained more or less flat in real terms, although the number of centres increased from 4 to 15 over the last fifty years (figure 15b).
4.3. Key agricultural policy reforms

Agriculture in India is critical for addressing the food security concerns of the people and also delivering higher economic growth. In this context, ensuring availability of food grain is deemed absolutely necessary, while the latter calls for providing a boost to the high value sector. The tough task of balancing these objectives will require the right incentives, institutions and investments and not knee jerk reactions.

It is quite evident that the prevailing incentives are somewhat skewed in favor of food grain sector and the policy domain is too focused on producing more food grains. Re-adjusting the incentives should strive for better food grain management that involves production, procurement, stocking, and distribution. Considering the geographical dimensions, incentives should shift to regions which are more suited for cereal or food grain production as envisioned under the second green revolution. The procurement network should focus on the eastern states in order to incentivize farmers. This would also provide an alternative to procuring from the northern states wherein rice cultivation may not be sustainable for very long given the increasing stress on groundwater reserves and soil health. It has been advocated for long that price policy should not be used for augmenting income levels, and procurement price needs to be delinked from minimum support prices. While the latter forms the floor price, the former should be linked to international price movements. Social safety net programs or direct cash transfer should be strengthened to provide income support to farmers.
Reforming institutions of grain marketing is long overdue; levy (upto 75% as observed in states like Punjab, Haryana, etc), taxation of primary agricultural commodities, restrictions under the Essential Commodities Act needs to be relaxed to create unified agricultural markets. The Model Act (amended Agricultural Produce Marketing Committee Act) envisioned in promoting private sector participation in agricultural markets but the zeal with which the states have introduced it has achieved very little in this regard. Other institutional arrangements related to water, land and credit need to be reformed. It is time to move away from subsidies and promote water use efficiency through water users’ association or integrated water management systems. Separating the feeder lines for agriculture and other uses as observed in the Jyotigram experiment in Gujarat can help monitor and regulate the use of power for irrigation purposes (Shah et.al.). While groundwater and other surface irrigation sources although clubbed as minor irrigation are major irrigation sources in India and there are limitations to exploit these resources as already observed in different regions in terms of groundwater water drafting and recharging. The rationale of pumping in financial resources need to be revisited in the light of the potential created and utilized. Simply investing in irrigation structure under major and minor category without adequate maintenance and regulation will not work into the future.

Land lease markets need to liberated and all deals related to agricultural land should be legal and transparent. This can pave the way toward consolidation of holdings and benefit from economies of scale. Agricultural credit market requires major overhauling and loan waivers are the least effective measures to address the plight of the farmers. The survey estimates of 2003 show that 42.4% of farmer households and nearly 50% of farmer households (possessing up to 2 hectares of land) avail loan from non-institutional sources (Gol 2007). Despite agriculture featuring as a priority lending sector, banks have failed to meet the targeted 18% (agricultural credit as percent of total commercial bank lending). Regulating the formal sector and rendering it more accessible to the farmers can help them avoid relying on informal sources. Unless these institutional changes are achieved, it will not be easy to attract investments in agriculture and more so from the private sector. Rural and agricultural extension services are critical to transfer the required market information and other essential services to the farmers. While the public sector led extension system in India has failed to delivery, there are emerging opportunities of public private partnerships in delivering these services. The concept of rural business/service hubs led by private companies such as DSCL- Hariyali Kisaan Bazaar, ITC-Choupal Saagar, etc have entered the market and there is need for better communication and coordination with the public sector run Krishi Vikas Kendras (KVks), Agricultural Technology Management Agency (ATMA), or other extension service networks and create synergies.
Rationalizing input and output subsidies can unleash the potential for greater investments in agriculture. Investments in rural infrastructure; roads, markets, cold chains, processing units as also agricultural R&D will be important to realize higher agricultural growth. Some of them which are of public good in nature will have to be taken by the public sector such as roads, markets and other infrastructure. Those pertaining to value chains, technology, etc will flow from the private sector. There are already private companies (domestic and multinationals) such as Future Group, Reliance, Bharti, Wal-Mart, Del Monte, Metro, etc investing in developing supply chains including backend operations.

5. Summing up

There is recognition amongst the Indian policymakers that the existing incentives and institutions need to be reformed to be able to boost investments that are critical for agricultural growth. The Mid Term Appraisal of the eleventh five year plan clearly states the need to reform the *three Is* (incentives, institutions, and investments) (Planning Commission 2010). However it remains a challenge before them to bring about these reforms and ensure their effective implementation. The two facets of Indian agriculture; traditional food grain sector and the high value sector need to be looked at with a balanced approach. While the former will be important from the food security point of view, the latter is more likely to deliver the targeted 4% agricultural growth. It is also recognized that the nature and size of investments that will be needed to rejuvenate Indian agriculture cannot be mobilized by the public sector alone and that the private sector will have a larger role to play. Reforms of the nature discussed above will be instrumental in inducing private sector investments in agriculture. The present and future revolutions in Indian agriculture will be increasingly driven by the private sector as observed in the case of Bt cotton or hybrid maize.
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