Putting Agriculture on the Takeoff Trajectory:
Nurturing the Seeds of Growth in Bihar, India

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--The boundaries and names shown and designations used on the map(s) herein do not imply official endorsement of acceptance by the International Food Policy Research Institute
1. Background

In 1876, A. P. MacDonnell, in his “Report on Food-Grain Supply of Bengal and Behar,” recorded average rice yield to be 1,000 to 1,200 kg/hectare (ha) in Tirhut and 500 to 1,700 kg/ha in Champaran (district average being 979 kg/ha) in a good year. He reported the double-cropped area to be 30–32 percent of cultivated land (cropping intensity of 1.3–1.32). In some parts of Champaran, cropping intensity was as high as 1.62 (MacDonnell 1876, cited in Hunter 1877/1976). In 2013, 137 years later, the population pressure on the land has increased fivefold and most people (81 percent of the workforce) are still employed in agriculture, nearly two-thirds of land has been brought under irrigation, and use of chemical fertilizers and hybrid seeds have become common—yet average rice yield is not much higher in these parts of Bihar. Cropping intensity, now around 1.4, has not increased significantly either. The Green Revolution bypassed the state in its first wave in the 1960s and 1970s. Subsequently, during a short interval in the late 1980s and early 1990s, the agricultural growth rate reached almost 3 percent per year, one of the highest in the country, though over a smaller base. Even this modest growth was short-lived, and stagnation has set in again. This report explores why.

Although the overall agricultural scenario of Bihar reflects slow growth and even stagnation, some regions in the state (like the Sone command area in south Bihar) and some crops (like maize) and allied activities (like the dairy and the livestock sector) show reasonable growth and dynamism. This report also explores such nascent sources of growth and discusses policies and investments that will put agriculture in Bihar on the takeoff trajectory.

Section 2 of the paper looks at both the long-term and the more recent trends in gross state domestic product of agriculture and allied activities (GSDPA) in Bihar and highlights the inconsistency in the secondary data that has misled some researchers to conclude that agricultural growth in the state had accelerated to more than 5 percent per annum after 2000/01. We show that this is not the case after the data inconsistency is accounted for. Section 3 discusses the slow change in cropping pattern, cropping intensity, and crop yields in Bihar and uses recent data to show that productivity has remained low in spite of rapid intensification of input use in the state over last two decades. In Section 4, we present the argument that floods in...
north Bihar and the high cost of irrigation across the state are two big reasons why crop productivity and cropping intensity continue to be low in Bihar. We also discuss problems of poor access to credit, markets, and lack of ensured prices for farmers in Bihar. Section 5 identifies some of the nascent sources of growth in agriculture in the state by exploring some crops (like maize) and allied activities (such as dairying) where productivity growth has been higher in Bihar than in the rest of India. Finally, Section 6 presents some policy imperatives for engendering sustained agricultural growth in the state.

2. Agricultural Gross Domestic Product of Bihar: Recent and Long-Term Trends

The value of output from agriculture and livestock in Bihar was 64,000 Indian rupees (Rs) per hectare for 2008/09; in contrast, the neighboring state of West Bengal, standing parallel with Bihar in terms of net cropped area and net irrigated area, is doing much better with the value of output per hectare at Rs 1.05 lakhs.\(^d\) A (relatively) low value of output per hectare indicates several constraints to the existing agricultural and allied enterprises and poor productivity levels in the state.

However, in recent times, the media and policy circles have the impression that the agricultural economy of Bihar has turned corners in last seven or eight years (World Bank 2007; India 2008; Gulati, Shah, and Sreedhar 2009; Bihar 2010). A report of the Special Task Force on Bihar claims that from 1993 to 2003, agricultural gross domestic product (GDP) of Bihar grew at 2.7 percent per year “which was next only to West Bengal and Andhra Pradesh among the major Indian states. A study for the period 1995–96 to 2004–05 not only confirms above findings, but also shows that Bihar went ahead of both these states, though marginally” (India 2008, 17–18). Gulati, Shah, and Sreedhar (2009) show that Bihar’s agrarian economy grew at 5 percent per annum from 2000/01 to 2007/08, compared with the national average growth rate of 2.9 percent. In yet another unpublished draft, Gulati, Shah and Sreedhar (2010) show that GSDPA for Bihar has registered a growth rate of 7.1 percent from 2000/01 to 2008/09 and 4 percent from 1993/94

\(^d\) The value of agricultural output of West Bengal, excluding livestock products, is more than twice as high as that of Bihar, even though the net cultivable land is slightly higher in Bihar.
to 2008/09. Another report card by the government of Bihar claims 5.58 percent annual growth in agriculture between 2004/05 and 2008/09.

Four to seven percent per annum is an excellent growth rate for agriculture, especially when compared with the approximately 3 percent annual growth in the rest of India. However, some important caveats to the GSDPA data of Bihar in recent years, when considered, make such high growth rate estimates seem suspect.

First, agricultural GDP of Bihar is highly volatile (Figure 2.1). The real GSDPA in the state has not had two consecutive years of growth since 1993/94. A year of increase in GSDPA is regularly followed by a decline next year (Bihar 2009). Therefore, the growth rate we arrive at is highly sensitive to the choice of the initial and final years. We need to look at the long-term trend, and in the short term, we should look at two-year moving averages to get a better picture.

![Figure 2.1](image)

Source: India(2010).

Second, there is a problem in the underlying GSDPA data. The Central Statistical Organization (CSO) reports a sudden jump in the value of milk output, from Rs 43.3 billion in 2003/04 to Rs 63.6 billion in 2004/05, an increase of 50 percent in just one year. The growth rate before and after this year has never exceeded 10 percent per year. An increase in the value of milk alone is responsible for 53.6 percent of the total reported increase in value of output between 2000/01 and 2005/06. This sudden jump in the value of dairy sector output in 2004/05 in Bihar is apparently due to a switch in the livestock census base from 1981/82 to 2003/04. In Bihar the last livestock...
census (prior to 2003/04) was carried out in 1981/82 instead of 1996/97 (as in other states). Hence, the milk production figures for Bihar prior to 2004/05 are based on the livestock population projections as per the 1981/82 census. This probably implies that the projections (based on 1981/82 census) were undervalued. This revision in value of livestock output accounts for a large fraction of the 5 percent growth in agriculture and allied sectors reported for the period of 1999–2005. The actual growth rate would be much lower. It also means that the growth rate of agriculture and allied sectors from 1982/83 to 2003/04 was somewhat higher than the CSO data suggest, as CSO underestimated the growth in the value of livestock outputs during this period. In sum, agricultural growth in Bihar was slightly faster during 1982–2003 and much lower during 1999–2005 than what we infer from the CSO data. CSO data show that since 2004/05, milk production in Bihar has grown at 6.8 percent as compared with 4.3 percent at the national level. This 6.8 percent growth rate is encouraging but hard to verify because the livestock census was not conducted again in 2007 in Bihar.

If we look at the long-term trend, agricultural growth in Bihar has been the slowest of that in all Indian states over the last five decades. According to Bhalla and Singh (2009), the compound annual growth rate (CAGR) in the value of agricultural output was a mere 0.7 percent from 1962/65 to 2003/06 (Table 2.1), the slowest of all states in India. Even if we updated the data to 2012/13, the growth figure is unlikely to change significantly because of three drought years (2009, 2010, and 2012) experienced in the state since 2006. The total population and the population of agricultural workers grew almost three times as fast during this period. In effect, per capita (and per worker) value of output of agriculture has been shrinking over the last four decades in Bihar (Figure 2.2).

Table 2.1 Compound annual growth rate (%) in value of outputs (44 crops) in Bihar

<table>
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<tbody>
<tr>
<td>Bihar</td>
<td>1.12%</td>
<td>−0.41%</td>
<td>2.07%</td>
<td>0.26%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Source: Bhalla and Singh (2009).
Note: The state of Bihar here includes both Bihar and Jharkhand of today. Agriculture growth after 2006 has been slow too due to three drought years in 2009, 2010, and 2012.

Figure 2.2


3. Understanding Agrarian Stagnation in Bihar

The value of agricultural output of an area would grow if (1) cropping patterns shift from low- to high-value crops, (2) the gross cropped area increases due to increase in land area sown more than once, and (3) and crop productivity increases. We explore trends in cropping pattern, cropping intensity, and crop productivity in Bihar in this section. An increase in the relative price of agricultural commodities could be another source of growth in value of agricultural output; however, we ignore this because relative prices can hardly be influenced by state policy or farmers’ initiatives.

3.1 Cropping Pattern

The effect of droughts showed up in National Sample Survey (NSS) consumption estimates too. The 66th round of consumption survey carried out in 2009/10 showed no decline in poverty in the state between 2004/05 and 2009/10 in spite of very high growth in GDP.
Agriculture in Bihar is dominated by the rice–wheat system (72 percent of gross cropped area, or GCA, in 2007/08), which offers low returns to land—the scarce resource—and does not require much labor or irrigation water, two resources that are in abundance in the state. Food grains (cereals and pulses) account for nearly 85 percent of GCA in Bihar—the highest percentage among all states in India—and their share in GCA has not significantly declined over the years, unlike in the rest of the country.

Kharif (monsoon) crop is beset by problems of flood and waterlogging in large areas of Bihar. In north Bihar, more than half of all cultivable land is flood prone. Altogether, floods frequently affect 41 percent of total cropped area in the state. Lowlands (tals, diaras, and chaunrs) f occupy another half-million hectares of land in both north and south Bihar (India2008). There is not much scope of crop diversification in the kharif season, and farmers have low incentives for intensive cultivation.

Since options are limited in kharif, one would expect that farmers would make the most of rabi (winter) and garma (summer) seasons by using cheap labor and abundant water available to grow crops that may be labor and water intensive but offer high returns to land. For example, in neighboring Bangladesh, which is also flood prone like Bihar, farmers have taken to summer paddy with much enthusiasm, and it has propelled this from a basket case in the 1970s (Alam, 2000) into a high agricultural growth trajectory. However, in Bihar, hardly any crops are cultivated in the garma season, and rabi cropping is dominated by wheat (60 percent of sown area), followed by pulses (18 percent), maize (11–12 percent), and oilseeds (4–5 percent). Both wheat and pulses are neither labor nor water intensive f and also offer low returns to land—the scarce resource in the state. Winter maize is different. It offers relatively higher returns and has become an important cash crop of Bihar, especially in the highly flood prone Zone II. The average maize yield in Zone II is almost 3 tons/ha, much higher than overall maize yields at the state and national level.

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f Tals (low-order monsoon stream), diaras (saucer-shaped flood plain of a river), and chaunrs (remnants of river course) are low-lying lands that remain inundated under deep water throughout the monsoon season and even afterward.

f Growing wheat requires relatively low labor input (55 man-days/ha), and only two to three irrigations (less than 2,000 m³ of water/ha) are applied (Kishore 2004).
Wheat yields are low in Bihar, and if farmers continue to follow the current crop calendar, yields are likely to remain low and somewhat unresponsive to input intensification. The recommended sowing time for wheat in Bihar is November 19–25, when kharif paddy is still in the field in much of the state (due to delayed sowing in July and August). A one-month delay in sowing of wheat reduces its yield by more than 50 percent (Singh et al. 2001).

Net return from wheat is less than Rs 5,000/ha. If one includes implicit costs of family labor and land rent, the net return turns negative (India2008). Yet farmers in Bihar continue to grow more and more wheat. The area under wheat production grew from one-sixth (17 percent) of GCA in 1970/71 to nearly one-third (27.4 percent) of GCA in 2007/08, even as yield remains stagnant and returns remain low. Similarly, pulses, the second major rabi crop group, are grown on residual soil moisture; traditional seeds are used and are not labor intensive. Rainfed pulse yields are low (<1000 kg/ha) not only in Bihar but throughout India.

In contrast to the dominance of cereals in the share of GCA, high-value agriculture (fruits and vegetables, livestock) is the mainstay of the value structure. Figure 3.1 shows the share of different segments as a percentage of total value of output from agriculture and allied activities in triennium ending (T.E.) in 2008/09 for Bihar and all-India.

**Figure 3.1**

![Pie charts showing the share of different segments as a percentage of total value of output from agriculture and allied activities in triennium ending (T.E.) in 2008/09 for Bihar and all-India.](attachment:image.png)

**Source**: India, National Account Statistics.
For Bihar, cereals constitute about 21.7 percent of the total value of output, paddy and wheat being the most prominent ones at 11.7 percent and 8.5 percent, respectively. This is comparable to the national average. The difference, however, shows up in the high-value sector, especially livestock and fruits and vegetables. Fruits and vegetables constitute about 20.5 percent of the total value of output from agriculture and allied activities in Bihar, while at the national level their share is 16 percent. This is quite understandable as the landholding size of the farmers is small and scattered and the enterprising farmers put in their best investments in small and safe irrigated pieces. The livestock sector, which is also considered as an investment and insurance by the smallholders, contributes about 35 percent to the total value of output in Bihar vis-à-vis 25 percent at the national level. Thus, the main characteristics of Bihar’s agriculture are high-value agriculture practiced on a small, safe area and low-value agriculture practiced on a large area.

3.2 Cropped Area

Bihar had net sown area (NSA) of about 5.9 million hectares (mha) and GCA of about 8.2 mha in 1967. Both NSA and GCA peaked in the triennium of 1976–1978 and have declined since then by about 5–10 percent. NSA has reduced by 0.3 mha and GCA by 0.9 mha from 1976–1978 to 2007/08. Overall, the long-term picture is that of stagnation or even slight decline in both net and gross cropped areas. The same is true of cropping intensity, which has hovered around 140 percent over this period. For a short while it reached 146–147 percent but did not sustain the high level and has fallen back to its long-term level (Figure 3.2). This is slightly higher than the national average (135 percent) but much lower than that in neighboring states like West Bengal (185 percent) and Uttar Pradesh (151 percent) with similar population pressures and irrigation ratios.
Increased population pressure creates demand for agricultural intensification (Boserup 1965), and access to irrigation makes agrarian intensification possible by allowing cultivation of second and third crops. In Bihar, the rural population and agricultural labor force (cultivators plus agricultural laborers) have increased by more than 80 percent, per capita agricultural land available has reduced by half (from 0.13 ha in 1971 to 0.07 ha in 2001), and gross irrigated area has increased by 67 percent between 1971 and 2001. Yet gross cropped area has remained stagnant or has even declined. We think that floods and the rising cost of irrigation are responsible for this stagnation in GCA in the state. We discuss both in detail in Section 5.

3.3. Production and Yield: Stagnant in Spite of Increased Input Use

Even if NSA and GCA stagnate and cropping pattern does not change, it is possible to increase total value of agricultural output by increasing yields and hence overall production of crops. Crop yields, however, have been rising very slowly in Bihar. From 1970/71 to 2006/08, yield growth has been slow for rice (1.27 percent per year) and wheat (1.49 percent per year), two
main crops that account for more than 70 percent GCA of the state.\(^h\) If we consider all crops, the value of output per hectare of GCA at constant price has increased at 1.06 percent per year in Bihar from 1962/65 to 2003/06, compared with 1.6 percent per year in the eastern region and 2.01 percent per year in all of India (Bhalla and Singh 2009).

Average rice yield in Bihar was 1,271 kg/ha in the triennium ending in 2010/11, which puts it in the lowest productivity group by the Directorate of Rice Development classification. If we look at the district-level data, all districts of North Bihar except West Champaran (1,863 kg/ha) are low-productivity districts with average yield less than 1,500 kg/ha, while in South Bihar, 6 out of 15 districts are in the low-productivity group. The picture is not much better for wheat either. Though wheat yield is higher than that of rice (2 tons/ha), the yield gap between Bihar and the rest of India is higher for wheat.

Fruits and vegetables account for about 4 and 11 percent, respectively, of the GCA in Bihar. The cropped area and production of fruits has been stagnant from 2000/2001 to 2007/08, exhibiting 0.9 percent and 0.5 percent growth, respectively, while the productivity has declined marginally. For vegetables, while both area and production have recorded high growth rates of 4.4 percent and 6.9 percent, respectively, the growth in productivity has been a low 1.7 percent per year (Figure 3.3).

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**Figure 3.3**

\(^h\) We do not consider the most recent triennium (2008–2010) because of two consecutive years of drought (2009 and 2010) in this triennium with lower yields. If we consider triennium 2008–2010 too, yield growth rate goes down to 0.8 percent and 1.4 percent per year for rice and wheat, respectively.
This record of stagnation in crop yields is striking, especially when seen in relation to trends in use of yield-enhancing assets and inputs. Both net and gross irrigated areas in Bihar have increased by more than 60 percent between 1971 and 2008, and the number of cultivators and agricultural laborers has doubled. The density of tractors has increased from 4 to 17 per thousand hectares of NSA, and the use of high-yielding varieties is much more common now (Table 3.1). Even more remarkable is the increased use of chemical fertilizers. In 1971, chemical fertilizers were barely used in Bihar (9.06 kg/ha); use remained quite low till the early 1990s (57.2 kg/ha in 1992/93) but has increased rapidly since then (Figure 3.4).
### Table 3.1 Input use and yields of major crops in Bihar and India in 1981/82 and 2001/03

<table>
<thead>
<tr>
<th></th>
<th>Bihar</th>
<th></th>
<th>India</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2001/03</td>
<td>1981/82</td>
<td>2001/03</td>
<td>1981/82</td>
</tr>
<tr>
<td>Labor availability (cultivators + ag laborers/100 ha)</td>
<td>379</td>
<td>222</td>
<td>166</td>
<td>104.28</td>
</tr>
<tr>
<td>% area irrigated</td>
<td>61</td>
<td>49</td>
<td>39</td>
<td>29</td>
</tr>
<tr>
<td>Fertilizer use (NPK/ha GCA)</td>
<td>95.79</td>
<td>21.54</td>
<td>91.45</td>
<td>34.34</td>
</tr>
<tr>
<td>Tractor density (#/1000 ha)</td>
<td>~17</td>
<td>2.46</td>
<td>~17</td>
<td>3.65</td>
</tr>
<tr>
<td>Pumps/100 ha</td>
<td>12.05</td>
<td>6</td>
<td>11.05</td>
<td>4.7</td>
</tr>
<tr>
<td>HYVs as % cropped area of rice</td>
<td>73.9</td>
<td>24.7</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>HYVs as % cropped area of wheat</td>
<td>92</td>
<td>76.9</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Rice yield (kg/ha)</td>
<td>1,469</td>
<td>858</td>
<td>1,967</td>
<td>1,266</td>
</tr>
<tr>
<td>Wheat yield (kg/ha)</td>
<td>1,912</td>
<td>1,353</td>
<td>2,695</td>
<td>1,691</td>
</tr>
<tr>
<td>*CV (rice yield) [1993/94 to 2010/11]</td>
<td>15%</td>
<td></td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>CV (wheat yield) [1993/94 to 2010/11]</td>
<td>9%</td>
<td></td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Percentage cropped area under high-yielding varieties (HYVs) for rice and wheat is from Annexure XX of India (2008). All other data are from Indiastat.com.

Notes: *CV is coefficient of variation. **NA = Data not available.
Labor, irrigation, fertilizers, high-yielding varieties, and mechanization are main inputs to increase yield. Today Bihar is at par with or ahead of the national average in availability (or use) of all these inputs (Table 3.1). This is confirmed from several data sources, such as the Situation Assessment Survey of Farmers in 2002/03 (NSSO 2005) that shows that 89 and 91 percent of farmers in Bihar reported using chemical fertilizers in kharif and rabi, respectively, compared with the national average of 76 and 54 percent. Similarly, in a primary survey done in 18 villages in Bihar by the International Livestock Research Institute (ILRI), 100 percent of respondents reported using chemical fertilizers and 80 percent of the land was under irrigation—almost exclusively irrigated by diesel pump sets (Thorpe et al. 2007). Still the yield gap between Bihar and India persists; in fact, the gap has widened from the time when Bihar lagged behind the rest of India in use of these inputs. This paradox of stagnant or declining output, in spite of increasing use of inputs, is difficult to explain. Why would farmers continue to invest in fertilizers if yields are not increasing? Similarly, why would farmers continue to buy new pump sets if the existing ones are already severely underutilized due to the high price of diesel?\(^1\)

We do not yet have good answers to these questions. Part of the explanation could be in what Shah (2007) found in the Simra village of Bihar, where sharecroppers and marginal farmers

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\(^1\) A recent IWMI survey of 406 diesel pump owners in three villages of the Vaishali district in North Bihar shows that an average diesel pump is in operation fewer than 100 hours in a year.
started intensive cultivation of irrigated onion crop during the summer “as a strategy to beat the rising cost of irrigation of wheat and other crops” (p. 4008). The onion crop required 13 irrigations (compared with 3–4 for wheat) and intensive use of fertilizers and labor, but also offered much higher returns than wheat. As the area under onion expanded, it stimulated more diesel pump purchases.

It may be so that, as in Simra, farmers across large areas of Bihar are shifting to cultivation of input-intensive high-value crops on small parcels of land and that this change is not being fully accounted for by our current data collection system, resulting in underestimation of agricultural output value. We could not find enough recent primary studies to verify this conjecture. Stagnant yield, in spite of high input use, is a puzzle that needs further research and more accurate data on cropping pattern and crop production to solve.

4. Why Agricultural Growth Is Slow and Volatile in Bihar
In the 1970s, the agrarian stagnation in Bihar and the rest of eastern India was believed to be due to low use of modern technologies and inputs in the region. The big research question was, Why are farmers in eastern India slow to adopt yield-enhancing inputs and practices? However, the input use patterns shown in table 4 suggest that the big question of 1970s and ’80s has become somewhat irrelevant today. Farmers in Bihar have caught up with the rest of India in input use by investing heavily into assets like tractors and pump sets and rapidly increasing their use of hybrid seeds and chemical fertilizers. If agrarian dynamism were to be measured by trends in farmers’ investments in yield-enhancing assets and inputs, then farmers of Bihar have shown greater dynamism in the last two decades than their counterparts in the rest of India. Now the question is, Why do these inputs and investments have low returns in Bihar?

We hypothesize that the poor infrastructure, poor incentives, and nonexistent technological support to farmers in Bihar negate private initiative and make it less productive. In other words, assets created by private initiative and investment are not being leveraged well due to lack of infrastructure and incentives.
4.1. The Energy Squeeze on Farmers in Bihar
Bihar is rich with groundwater. As per the minor irrigation census (2000/01), about 74 percent of the villages in Bihar have groundwater levels within 10 meters’ depth. The alluvial soil in the top layer and shallow groundwater levels make digging of tube wells (relatively) easy and economical, and farmers in Bihar have invested heavily into pump sets and bores in recent years. The number of shallow tube wells (STWs) in Bihar has doubled between the two minor irrigation censuses and at a fairly greater pace than that of the national average. As a result, access to irrigation is widespread now across all landholding groups. In the World Bank’s Living Standards Measurement Survey (LSMS survey in 1998, 78 percent marginal, 70 percent small, 57 percent semi-medium, 54 percent medium, and 59 percent large farmers report all (100 percent) of their land as irrigated at least once in the year. Public data also show that 61 percent of NSA in Bihar is irrigated, compared with the national average of 40 percent. But irrigation intensity remains quite low in the state, resulting in low or partial irrigation.

Farmers under-irrigate their crops because irrigation is expensive, though plenty of water is available at shallow depths. Almost all groundwater irrigators in Bihar irrigate from diesel pump sets—own or rented. Eighty-five percent of pump sets in Bihar run on diesel (India2001) and 97 percent of irrigators irrigate their lands from diesel pumps (NSS estimate, cited in World Bank 2007), because there is no electricity in half of the villages of the state, and even in the other half, the power supply is extremely poor and unreliable. An increase in the price of diesel raises the cost of irrigation for those who irrigate from diesel pumps. The increase in cost is even higher for water buyers (Shah 1993, 2007). In a survey by World Bank in 1997/98 that covered a random sample of 1,035 households in Bihar, more than 70 percent of farmers reported buying irrigation (LSMS 1997/98). This is corroborated by the NSSO 54th round (1999), that shows that 68.6 percent of farmers in Bihar report hiring in irrigation services from others—the highest among all states in India (Mukherji 2008).

Thus, more farmers in Bihar depend on diesel pumps for irrigation than in any other state, and a large proportion of them buy water. The retail price of diesel has increased rapidly over the last few years (and shall continue to increase as per the recent policy on diesel pricing), while food prices have failed to keep up (Figure 4.1). The price of diesel increased by 670 percent between
1990 and 2006, while the farmgate price of rice rose by only about 60 percent. This worsening of terms of trade is one of the drivers of trends in production and yield that we observe in Bihar: the return back to slow growth after a short period of acceleration in the 1980s and early 1990s. Rapid development of groundwater irrigation in the 1980s unleashed agricultural growth, but it was quickly reversed by the pincer movement of falling food prices and rising diesel prices. The phenomenon was observed in West Bengal (Mukherji 2006) and eastern Uttar Pradesh too: two neighboring regions with high dependence on diesel-fueled irrigation. However, the effect was deeper on agriculture in Bihar because of (1) greater dependence on diesel pumps and (2) lower productivity of agriculture in the state to begin with. Low productivity of agriculture in Bihar makes it more vulnerable to any input price shock.

**Figure 4.1**

![Diagram showing wheat and paddy production](image)

Source: Data on retail price of diesel and farm-gate prices of wheat and paddy taken from indiastat.com.

The high and rising cost of irrigation with diesel pumps is also a reason for low cropping intensity in Bihar. Floods limit options and incentives to intensify agriculture in the kharif season, yet farmers rarely cultivate their land in summer; and in rabi too they choose to grow mostly wheat and pulses—crops that require less water but also offer low returns. The rising price of diesel discourages farmers—pumps owners and water buyers—from growing second
and third crops, hence, the low cropping intensity. The nominal price of diesel is negatively correlated with cropping intensity ($\rho = -0.46$). After we control for linear time trend, the association becomes stronger ($\rho = -0.61$) and it is statistically significant at the 99 percent confidence level (Table 4.1). The coefficient implies that a Rs 1 increase in the nominal price of diesel is associated with reduction in cropping intensity by more than one-half of 1 percent in Bihar.

**Table 4.1 Effect of price of diesel on cropping intensity and production of wheat**

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
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<tbody>
<tr>
<td>Diesel price</td>
<td>–0.606*</td>
<td>–52.61*</td>
</tr>
<tr>
<td></td>
<td>(0.146)</td>
<td>(15.24)</td>
</tr>
<tr>
<td>Wheat area</td>
<td>1.48*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.54)</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>0.324*</td>
<td>98.02*</td>
</tr>
<tr>
<td></td>
<td>(0.111)</td>
<td>(15.00)</td>
</tr>
<tr>
<td>Constant</td>
<td>–498.8**</td>
<td>–194093*</td>
</tr>
<tr>
<td></td>
<td>(219.2)</td>
<td>(29047.18)</td>
</tr>
<tr>
<td>Observations</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.39</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* p<0.01, ** p<0.05

Source: Regression using data on retail price of diesel on March 31 every year; cropping intensity and wheat production from www.Indiastat.com.

Note: CI is cropping intensity (%), wheat production is in thousand tons, and wheat area is in thousand hectares.
A very large share of Bihar’s cultivable land is under the rice–wheat cropping system. The average combined yield of two crops is less than 4 tons/ha in the state. Indian Council of Agricultural Research (ICAR) field experiments show that yields of both rice and wheat crops could be increased by advancing transplantation of kharif paddy by a month in areas where flooding and waterlogging is not a problem (Singh et al. 2001). Advancing the schedule, however, would require intensive irrigation in preparation of paddy seedbeds and transplantation of seedlings, but irrigating with diesel pumps is prohibitively expensive and requires ready cash. Hence, farmers prefer to wait for monsoon rains and forgo the opportunity to increase yields. The high cost of irrigation is, therefore, one of the biggest hurdles in large-scale adoption of this proven strategy of yield enhancement in rice–wheat systems of Bihar (Kishore 2004).

Expensive irrigation negates the natural advantage that Bihar enjoys, being water rich. The drought of 2009 illustrates how: Bihar was one of the most affected states. The area transplanted under kharif paddy went down to 18 mha from the normal area of 34 mha due to the drought. This was the second-highest percentage reduction in paddy area, after that in Jharkhand, in all of the states. As on August 12, 2009, rainfall was deficient or scanty in 27 of 36 meteorological subdivisions of India. In Bihar, rainfall was 40 percent below the normal. The deficit was comparable in Punjab (35 percent) and much worse in eastern Uttar Pradesh (53 percent), western Uttar Pradesh (68 percent), Haryana (66 percent), and Andhra Pradesh (46–59 percent)—yet the percentage reduction in area under paddy was much lower in all these other states. In Punjab, the reduction was barely perceptible in the data (0.7 percent); in Haryana it was just 10 percent. The figures were high for Andhra Pradesh (29 percent) and Uttar Pradesh (36 percent), yet significantly lower than those in Bihar (57.7 percent). At the national level was a 20 percent reduction in area under kharif paddy in 2009; in Bihar the reduction was 57.7 percent—more than twice as high (Business Line 2009). The reason for such drastic decline in Bihar, and not elsewhere, we claim, is lack of affordable irrigation. In Punjab, farmers coped with rainfall shock by resorting to groundwater irrigation, made affordable by free electricity. In Bihar, farmers could not afford to transplant paddy using groundwater irrigation—simply because the cost of providing that irrigation was uneconomic given the overall crop economics, and even the irrigation infrastructure was lacking. A farmer in Bihar might be paying 30–40 times as much cost for a unit of water as his counterpart farmer in Punjab and Haryana (Shah et al. 2009).
Irrigation capability in a region depends directly upon the available irrigation infrastructure and the access to water and less on the amount of water available in the region.

4.2. The Credit Squeeze
Irrigation with diesel fuel is not only expensive, but it also requires cash-strapped farmers to make up-front payment for diesel in cash or the rent for hiring the pump. In absence of institutional lenders, farmers borrow at high rates. Bihar is not only the least electrified state of India but it also has the least number of banks. Bihar has only one bank branch for every 13 villages and the credit–deposit ratio is 32 percent, in contrast to 73 percent at the national level (India2008). The high cash outlay of irrigation combined with costly and scarce credit makes intensive irrigation unviable for most farmers in Bihar.

4.3. The Price Squeeze
The problem of the energy squeeze and credit squeeze is only worsened by the price squeeze. Let us illustrate how. On August 20, 2009, Agriculture Minister Sharad Pawar announced an increase in minimum support price (MSP) of rice from Rs 850/quintal to Rs 1,000/quintal. He also promised open-market interventions by Food Corporation of India (FCI) to keep food grain prices in check and discourage speculators and hoarders. Increasing the MSP of rice would have encouraged farmers of Punjab, Haryana, Western Uttar Pradesh, and Andhra Pradesh—from where FCI procures the bulk of its rice—to invest more in supplementary irrigation and other inputs to drought-proof their rice crop. In Bihar, this increase in support price did not matter to farmers’ crop economics because of little procurement by FCI in the state. In 2005, FCI procured only 7 percent of total kharif production of Bihar; while in Andhra Pradesh, Haryana, Punjab, and Uttar Pradesh it procured 78 percent, 64 percent, 87 percent, and 28 percent of kharif production, respectively. For wheat, procurement from Bihar is negligible. Distress sale of rice and wheat below MSP is common in the state. Farmers receive a price 10–20 percent below the MSP.

At the same time, open market intervention announced by the government—when successful—means that prices remain suppressed in spite of scarcity. Producers of Bihar would have gained
little from the first (price support) policy, but lost substantially due to the second (open-market intervention).

In 2011, the government of Bihar launched a massive effort to increase procurement of paddy from 0.866 million tons in 2010/11 to 3.0 million tons during the kharif season of 2011/12. The government set procurement targets of 1.8 million tons, 0.7 million tons, and 0.5 million tons for primary agriculture cooperative societies, Bihar State Food Corporation, and FCI, respectively. Six thousand new collection centers were opened to facilitate procurement, and farmers were promised immediate payment for their paddy through account payee checks. The state cabinet approved a budget of Rs 800 crores to pay farmers.

The state procured 1.53 million tons of paddy in 2012 out of the estimated total production of 8.1 million tons. The actual procurement was only about half of the target (3 million tons) set by the government at the beginning of the marketing season, but still it was 75 percent higher than the amount procured in the previous year—a big improvement. Increasing the direct procurement of paddy from farmers is challenging in Bihar because most farmers have a very small marketable surplus, which raises the transaction costs for both the procurement agency and the farmer. Some intermediate aggregation at the village or helmet level may help to address this problem. The state government has retained the procurement target of 3 million tons in 2013/14 in spite of relatively lower expected output of paddy this year.

4.4 Agricultural Marketing and Food Processing Industry
The government of Bihar abolished the Agricultural Produce Marketing (APMC) Act in 2006, and since then no act or law has governed the functioning of agricultural markets. The state government came out with a whopping Rs 1,272 crore plan to develop infrastructure for agriculture marketing (Bihar2008). The idea was to enhance private-sector participation through a four-tier marketing channel. Experiences from fieldwork conducted for an IFPRI study suggest that the progress is almost negligible. Interesting to note is that in the three years since the APMC Act was abolished, no serious interventions from the private sector have occurred, neither to develop market infrastructure nor to innovate marketing channels. The post-APMC era seems to have had mixed experiences for different stakeholders. For the farmers, the liberalized regime
it seems has not been significantly different from the APMC days. They continue to sell their produce to the village aggregator, who takes the collected produce to the nearby *mandis*\(^1\). This keeps the farmers isolated from the institutional changes coming up in the markets, at least in the short run. On the other hand, the benefits of the liberal market environment seem to be in favor of the processing industries. They now have increased options for sourcing their produce without paying mandi taxes at multiple points. However, because of a derisory food processing industry, the impact of these benefits has been limited.

In Bihar only 2–3 percent of the total fruits and vegetables go through any kind of processing activity, quite similar to the national scenario. But for Bihar, food processing is much more critical as the agriculture output is dominated by the high-value segment, which is extremely perishable in nature. Similarly, an integrated value chain for winter maize to process it for starch and animal feed and use the locally produced feed for the dairy cattle will spur a win-win situation for the maize farmers, traders, industrialists, livestock farmers, dairy industry, and finally the consumers of milk and milk products. Bihar accounts for less than 2 percent of total industrial units in India, and the food processing capacity of the state (which is largely unorganized) accounts for less than 1 percent of the country’s capacity (IL&FS 2007). The food processing industry in Bihar grew at an estimated 3.6 percent between 2004 and 2007, which was much lower than the national average of 7 percent (IL&FS 2007). Rice milling and milk processing are the only significant food processing operations present in the state. Litchi, mango, makhana, and winter maize are crops commonly grown in Bihar, along with other crops like banana, potato, and others that have (relatively) high potential for food processing. Bihar has litchi processing capacity of 5,000 tons (just 5 percent of the production) and almost negligible processing capacity of mango, makhana, and maize. To have a thriving food processing industry, the basic infrastructure in the state needs to be brought to a minimum threshold level. Currently, it seems, Bihar has neither efficient marketing channels nor a requisite infrastructure for a thriving food processing industry. Unfortunately, Bihar farmers are forced to sell their produce in the unregulated markets, largely for table consumption, and are stranded from more remunerative options.

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\(^1\) *Mandis are*
4.5. The Poor but Improving Roads

A good road network is crucial because it links producers to the markets. Rural roads are one of the most effective public spending items in promoting agricultural growth and poverty reduction (Fan, Gulati, and Thorat 2008). About 8 percent of the country’s population residing in Bihar is supported by only 2.7 percent of the country’s total road network. Bihar has poor road density both in terms of road length per square kilometer and road length per lakh population (see Table 4.2).

Table 4.2 Some features of road sector in Bihar and India

<table>
<thead>
<tr>
<th></th>
<th>Length/sq. km.*</th>
<th>Length/lakh population*</th>
<th>% Surfaced state highways^</th>
<th>% Single-lane national highways*</th>
<th>% villages connected*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bihar</td>
<td>0.98</td>
<td>111</td>
<td>41</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>India</td>
<td>1.25</td>
<td>360</td>
<td>60</td>
<td>35</td>
<td>62</td>
</tr>
</tbody>
</table>

Sources: * Bihar(2009). ^ India(2009b)

Prior to 2004/05, the road sector was in a very bad shape. About 39 percent of the roads in the state were paved, compared with the national average of 57 percent (India2009). States like Gujarat and Haryana are far ahead, with 91 percent and 93 percent paved roads, respectively. According to a Planning Commission report, about 30 percent of the inhabited areas in the state are connected with motorable roads—the lowest percentage in the country (India, Planning Commission 2007b). The road network at the national level increased by about 99 percent since 1990, while Bihar’s road network has grown by just 27 percent during the same period (Bihar2009). The expenditures on the road network are at an alarming level in the state. Bihar accounted for less than 1 percent of the country’s total state-sector expenditure on roads for the Tenth Five-Year Plan. The Planning commission identified (a) a weak construction industry, (b) lack of good contractors, and (c) deficient tendering procedures as some of the major constraints for development of the road sector in Bihar (India2007b). Annual damage by floods is another challenge for construction and maintenance of a good road network.

However, post-2004/05, things have changed dramatically. The state government has placed good emphasis on construction of paved and all-weather roads to provide connectivity to all inhabitations. The physical and financial achievements in the road sector have been stupendous. The expenditure of the Road Construction Department has increased 18-fold from Rs 1.33 billion
in 2004/05 to Rs 24.8 billion in 2008/09. This expenditure has resulted in a sixfold increase in the road length during this period. Apart from this, about 3,000 km of roads have been upgraded and improved. Similarly the construction of bridges has also been expedited. The efforts from the state government seem to be notable and have been very well appreciated by the public and media. The future lies in strengthening and expanding these efforts for a long time to make up for past deficits.

4.6. Floods as Reason for Stagnation and Volatility in Agriculture

With 73 percent of Bihar’s total geographical area being flood prone, its agriculture sector is in jeopardy every monsoon. Bihar accounts for about 17 percent of the flood-prone areas and 36 percent of the flood-prone population of the country (C. P. Sinha 2008). As many as 30 of the state’s 38 districts are flood prone (Figure 4.2), including all 21 districts of North Bihar. On the one hand, the complex river system has bestowed the state with rich alluvial soil; while on the other hand, the unregulated supplies of water have handicapped the state with frequent floods. Inadequate management of the vast water resources has been identified as one of the primary reasons behind the state’s poor economic and agriculture performance (Rorabacher 2008). An old body of literature ascribes agrarian stagnation in eastern India to its flood-prone ecology (Ballabh and Sharma 1992; Ballabh and Pandey 1999; Boyce 1987). Crop yields are indeed lower in parts of Bihar where flooding is a bigger problem (Table 4.3). Imminent danger of floods and farmers’ risk aversion for supply of inputs clearly seem to be key reasons for low productivity of paddy in Zones I and II. The smaller farmers in these zones cited possibility of floods as one of the key reasons for underinvesting in kharif paddy. Instead they prefer investing in the more secured rabi crop, but as discussed earlier, the high cost of irrigation limits their options in rabi season.
Bihar has witnessed as many as five major floods in the last 12 years. The floods in 2004 damaged about 24 lakh ha of cropped area, resulting in a drop of about 31 percent in the food grain production. In 2002, when about 400 out of the 600-odd districts of the country were experiencing drought, 25 of the 38 districts in Bihar were hit by severe floods. From 1990 to 2006, floods have caused about Rs 92.57 billion in damage (at 2006 price level), that is, an average about Rs 5.78 billion each year. The floods in 1998, 2002, and 2004 were the most disastrous and accounted for more than 60 percent of the total damage (Figure 4.3). When the

Table 4.3 Flood-affected area and crop yields in the three agroclimatic zones of Bihar

<table>
<thead>
<tr>
<th>Agroclimatic zone</th>
<th>% Net sown area affected by floods</th>
<th>Rice yield (tons/ha)</th>
<th>Wheat yield (tons/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest Bihar</td>
<td>44</td>
<td>1.30</td>
<td>1.81</td>
</tr>
<tr>
<td>Northeast Bihar</td>
<td>84</td>
<td>1.14</td>
<td>1.58</td>
</tr>
<tr>
<td>South Bihar</td>
<td>6</td>
<td>1.88</td>
<td>2.20</td>
</tr>
</tbody>
</table>

Source: Percentage net sown area affected by floods calculated from Annex III, India(2008).
whole country was talking of a drought in August 2009, about 200 villages in Sitamarhi District of Bihar were flooded due to a breach in the embankment of the River Bagmati. The mayhem created by the Kosi floods in 2008 is still afresh. About 1,000 villages were drowned in six districts (Saharsa, Supaul, Araria, Madhepura, Khagaria, and Purnia) of the state, affecting 30,000 families and devastating 35,000 ha of crop fields (Dixit 2009) with the floods in Kosi being declared as a national calamity.

**Figure 4.3**

Source: Compiled from the data released by the Disaster Management Department, Government of Bihar.

Since 1990, floods have caused more than 3,000 human deaths and about 12,000 animal deaths, which seem to be much more severe than the monetary losses. Apart from this, huge indirect costs include social distress, outbreak of diseases, and private financial losses. The impact of floods is chronic, damaging infrastructure such as roads, houses, schools, electricity, telephone networks, and so forth. About 92 percent of the road network was destroyed in the districts hit by the Kosi floods, almost paralyzing the transport system in these areas. The poor are hit severely as they lose productive assets such as livestock, seeds, and farm equipment, besides employment opportunities. Through discussions with the agricultural officials and Bihar State Co-operative Milk Producers’ Federation Limited COMPFED producers, it appears that additional to the damage directly from floods, agriculture and livestock production also suffers from lack of
standby resources and systems for supplying replacement seed, fodder, and so forth to the affected areas. The shock due to floods results in distress sale of assets such as livestock, making the farmers much more vulnerable. The drop in COMPFED’s procurement in 2007–2009 is an apt indicator of such a behavior. Though the intensity and damage due to floods varies from year to year, it has made resource-poor farmers to be extremely risk averse. As discussed earlier, they prefer to delay the use of proper inputs for the more sure rabi season.

Recent reports suggest that floodwater stays longer and spreads to a wider area than it used to just a few decades ago (Mishra 2008).

4.6.1 Taming Floods: Options and Opinions
Taming floods seems to be one of the most critical and intricate challenges faced by the state. The major flood management effort from the Central and Bihar Government has been construction of embankments. Some experts believe that construction of embankments has not helped much in reducing damage due to floods (R. Sinha 2008; Dixit 2009; Iyer 2008; Rorabacher 2008). Several floods in the states, including the devastating Kosi flood of 2008, have been due to sudden breaches in the poorly maintained embankments. These floods are much more disastrous because they are unanticipated and the people are caught unaware. A number of experts have echoed diverse opinions and have suggested prospective alternatives on the issue of flooding in Bihar. Here we look at multiple options and attempt to cluster them as short-, medium-, and long-term measures for taming or managing the floods in the state.

Short-Term Measures. Cultivation of flood-resistant rice varieties in the vulnerable districts and promotion of crops that require high amounts of water, such as sugarcane, can contribute to flood-proofing efforts. Though this might not seem to be a major effort, it has potential to bring down crop losses. Moreover, it would help preserve farmers’ interest while the long-term efforts ensure security and stability. However, to bring sugarcane back to the fields, the sugar industry in the state needs to be revived. History beckons that Bihar led India in cane and sugar production (see Box 4.1). Unfortunately, the state-driven setup of the mills started crumbling, and sugarcane lost the interest of the farmers. However, some efforts have been made recently to
put the sugar industry on a revival track. The other option shall be an improved and community-based management of the depressions, ponds, and reservoirs for fisheries and aquatic crop production. As farm boundaries coalesce during the floods, the individual interventions are infeasible, but state and nongovernmental organization–assisted community ventures with agreed cost and profit-sharing mechanisms have the potential to succeed.

Experts have argued that an efficient flood information and relief management system should be developed to help minimize the damage done by floods. Development of such a system becomes necessary for reducing the intensity and damage. To deal with this the government of Bihar, with support from the World Bank, set up a Flood Management Information System (FMIS) under the Water Resource Department in 2007. The objective of the initiative is to improve preparedness of the state as a whole by analyzing and disseminating information related to floods. FMIS comes out with flood forecasts and guidelines for flood management and relief operations on a regular basis. Recent examples have shown that when flood information is precise and provided with sufficient lead time, communities come up with innovative and effective adaptation and mitigation plans and thus losses are minimized. The needed relief resources for the vulnerable areas must be stocked in advance at safe locations to boost the confidence and coping strengths of the communities.

Medium-Term Measures. According to Dixit (2009), “Approaches to flood mitigation that combine flood-adapted structural elements (improving drainage, houses on stilts, raising the plinths of the houses etc.) with other (transport, financial, communication etc.) systems that contribute towards building social resilience could be an effective alternative to historical approaches” (of flood control) (p. 78) He further suggests that “improving access to core services such as drinking water supply, reliable energy, health services and empowering women and community institutions contribute to social resilience and could serve as the cornerstone” of better management of the annual floods (Dixit 2009, p. 78). These approaches would help in building endurance to floods by means of collective action but might take some time to spread across all the communities and inhabitations in the vast flood-prone areas of the state. There could be some structural medium-term measures as well. South Bihar is a water-scarce area, quite contrary to North Bihar. This has prompted the state government to consider interlinking of
rivers within the state. Six out of the 30 canal links envisaged in the ambitious National Interlinking of Rivers Project lie in Bihar. Implementation of these links might play a role in reducing the intensity and frequency of floods in North Bihar. The state government has also proposed diversion of water from the flood-prone rivers of North Bihar to different rivers in South Bihar. The links would also help irrigate about an additional 1.2 million ha. With the long-term measures still far on the horizon, such medium-term efforts lie in the domain of the state government and can be effective.

*Long-Term Measures.* Investment in multipurpose projects across the overflowing rivers of Bihar has been a topic of long debate. Some (C. P. Sinha 2008) find that investments in dams can contribute significantly toward managing floods in Bihar, while others (Iyer 2008; R. Sinha 2008; Dixit 2009) do not see it as a solution at all. All the flood-prone rivers that drain Bihar originate from the adjacent steep Himalayan ranges in Nepal. The majority of the catchment areas of these rivers and suitable sites for construction of the dams and barrages lie in Nepal. Bihar can only look to the central government for investments and effective negotiations through transboundary agreements. After the Kosi floods, N. K. Singh (member, Rajya Sabha, and noted bureaucrat from the state) mentioned that more than the failure of the embankment, “the failure of our bilateral diplomacy with Nepal”, brought miseries to lakhs of poor people each year (Singh 2008). A number of projects have been envisaged between the Indian and Nepalese governments, but with little outcome so far. An estimated total investment of about Rs 450 billion in these multipurpose projects might help to reduce the damages done by floods along with provide benefits of irrigation and power generation. Under similar situations, the Union Government has made effective arrangements with the government of Bhutan for India to purchase most of the power produced through hydroelectric dams located in Bhutan (built by India), thus creating a win-win situation for both the countries. A better regulated river system brings good benefits to all the riparian countries. Further, controlling waters of these rivers might also reduce expenses occurring due to construction and maintenance of embankments. According to Bharati (1991), “Such is the racket of breaches that out of the Rs 250–300 crore spent annually by the Bihar government on construction and repair works, as much as 60 per cent used to be pocketed by the politician-contractors-engineers nexus” (p. 2186).
Flood proofing or improved flood management needs to be a high priority to bring stability in Bihar’s agricultural dynamism, which is currently fragile and cannot bear the brunt of floods anymore. Some coping mechanisms to deal with floods are cultivation of *makhana* and integrating it with fish cultivation. But these are limited to the small (although several) water bodies. What about the vast agricultural land? How should productivity of the kharif crops, especially paddy, increase? One needs to find solutions to make crop cultivation beyond subsistence levels. This can happen only after the threat of floods is minimized, if not eliminated. Management of the turbulent river waters in Bihar probably needs a multipronged strategy of short-, medium-, and long-term measures. With water becoming a scarce resource in most other states of the country, the onus lies on both the state and central governments to develop and implement an integrated and time-differentiated plan to convert this annual threat of misery, distress, and low productivity to a sustainable opportunity of regional endowment and high productivity.

5. Sources of Growth in Agriculture in Bihar

Though the overall growth in agriculture in Bihar has been slow and uneven, some crops and allied activities show positive deviance. We discuss three of these—livestock, fruits and vegetables, and winter maize—in some detail in this section.

5.1 Livestock

Livestock accounts for about 35 percent of the total value of output from agriculture and allied activities in Bihar (for T.E. 2008/09), almost 10 percent higher than the national average of 25 percent. Milk is the most important livestock product in Bihar, with a share of 71 percent of the livestock output (for T.E. 2008/09). Bihar produces about 5.4 million tons of milk annually, almost 5.4 percent of the total milk produced in the country; and since 2004/05, milk production in Bihar has grown at 6.8 percent as compared with 4.3 percent at the national level.

The real relief to the milk producers has been the success of the dairy cooperative in the state. COMPFED is the biggest organized player of the dairy sector in the state. Presently, COMPFED procures only about 2.6 percent of the total milk produced in the state (compared with more than 38 percent in Gujarat and 26 percent in Karnataka). However, the federation’s procurement has
grown by an annual average growth rate of 14.1 percent from 2000/01 to 2009/10 (COMPFED 2010) and has shown an impressive upward trend since 2000, except for 2007 and 2008 (Figure 5.1). In 2007 and 2008 Bihar witnessed turbulent floods. Large patches of agricultural land were damaged, resulting in stark scarcity of fodder. Many farmers could not bear the brunt of the floods and started selling their cattle. As a result, the federation’s procurement dropped by 21 percent and 13.5 percent in 2007/08 and 2008/09, respectively. Through discussions with COMPFED officials, we learned that it took a concerted effort from the federation and state government to discourage distress sale of livestock and arrest the downward trend in milk procurement.

**Figure 5.1**

![Graph showing milk procurement](image)

Source: COMPFED (2010).

COMPFED markets its product under the brand name Sudha and offers 20 different milks and milk products. Greater emphasis has been placed on marketing liquid milk and milk products in the last 10 years. The quantity of liquid milk marketed has crossed 7 lakh liters per day (LLPD) in 2009/10, an increase from 3.3 LLPD in 2001/02, and is expected to cross 9 LLPD in 2011. Similarly marketing of milk products has doubled since 2001/02. COMPFED’s success has enabled it to sell its milk beyond the state boundaries. Apart from selling milk and milk products in the nearby state of Jharkhand, in 2009 the federation commenced indirect selling of the surplus disposable milk to distant markets in Delhi and Kolkata markets through Mother Dairy and AMUL, respectively. This is just the beginning of a success story, and a modest target of 10
percent for the organized procurement of total milk production shall improve both milk productivity and profit margins of livestock farmers.

5.2. Fruits and Vegetables
Bihar produces about 9.6 percent of the total fruits and vegetables in the country. It ranks third and sixth in vegetable and fruit production, respectively, among all Indian states. Fruits and vegetables account for about 14.5 percent of the GCA of the state (TE 2006/07). Vegetable production has shown some signs of growth since 2000/01 (Figure 5.2). Area, production, and productivity for total vegetables have increased at an annual average growth rate of 4.4 percent, 6.9 percent, and 1.7 percent, respectively, from 2000/01 to 2007/08. The basket of vegetables is diversified in the state, with potato accounting for about 38.0 percent of the area under vegetables. Other vegetables include onion, tomato, cabbage, cauliflower, pointed gourd (parwal), and okra. These vegetables have small shares and do not account for more than 8 percent (each) of total vegetable area. Interesting to note is that none of these vegetables has shown significant growth in area, production, or yield since 2000 in Bihar. Probably the growth is coming from the smaller set(s) of vegetable groups. Vegetable farmers in the remote and unconnected areas also produce large amounts of vegetable seeds that are nonperishable and highly profitable.
As mentioned earlier, the fruits sector has had no significant growth. Mango, banana, and litchi are the main fruits in Bihar, accounting for about 50.0 percent, 10.6 percent, and 10.4 percent of the total area under fruit cultivation. The state accounts for about 8.5 percent and 53.0 percent of mango and litchi produced in the country respectively (for T.E. 2007/08). The yields of mango have been highly volatile since 2000/01, along with almost no real increase in the area under mango cultivation. Yields of litchi, on the other hand, have recorded a real drop from 12 t/ha (T.E. 2000/01) to about 7.5 t/ha (T.E. 2008/09), and the production has suffered in spite of a 2.8 percent annual growth in area since 2000/01. However, the crop fetches a high premium in the large urban markets in India and has a large export potential to the Middle East, Europe, and North America.

The high share of fruits and vegetables in agriculture demands a robust and modern infrastructure at all levels of the supply chain, including dependable and efficient small irrigation systems. Unfortunately, Bihar lacks it at all levels. Some of the successful techniques such as

Figure 5.2

Source: Bihar(2010).
banana plantations raised through high-yielding and early-maturing tissue-cultured plants, high-density and high-yielding mango and litchi plantations, drip or microsprinkler-raised high-density bed-planted onions, and large-scale adoption of high-yielding varieties of potato hold good promise for the state. To support 10 percent of the country’s total fruit and vegetable production, Bihar has just 5.6 percent of the country’s total cold-storage capacity, out of which 40 percent is defunct (World Bank 2007, 75). As a result, about 10–40 percent of the state’s horticulture produce is lost every year. Bihar scores low on the processing and value-addition front as well. Only about 2–3 percent of the total fruits and vegetables go through any kind of processing in the state.

5.3. Winter Maize
Productivity of maize in Bihar is 2,541 kg/ha, which is far greater than the all-India average productivity of 1,907 kg/ha. Bihar stands third in maize production in the country (for TE 2007/08) and winter (rabi) maize is one of the distinctive crops of the state. Winter maize covers about 32 percent of the GCA under maize in Bihar and accounts for around 42 percent of the total maize production (for T.E. 2007/08). Area, production, and yield of winter maize have recorded an annual average growth rate of 1.8, 8.7, and 6.5 percent respectively. The yield of winter maize in Bihar is about 3.5 tons/ha (for T.E. 2007/08), which is almost double that of the national maize yield of 2.1 t/ha (for T.E. 2007/08). Maize enjoys much higher area under irrigation in Bihar: 58 percent of the GCA under maize in Bihar is irrigated, as opposed to the national average of 21.5 percent (for T.E. 2006/07). The potential yield of winter maize is estimated to be as high as 6–8 t/ha. Seed companies in the private sector have been providing hybrid seed varieties for maize in Bihar that has increased the seed replacement rate from 21 percent in 2000/01 to 80 percent in 2009/10 for winter maize. Fortunately, both traditional and hybrid seeds are grown in the state and are increasingly replacing rainfed rice in the kharif season and irrigated wheat in the rabi season.

Demand of maize comes largely from three sectors: poultry feed, livestock feed, and human consumption. Per the World Bank (2007), 35 percent of the maize demand in Bihar comes from the cattle and poultry feed market. Poultry production is relatively small in Bihar. Bihar accounts for about 2.8 percent (2003) and 2 percent (TE 2006/07) of the total poultry and egg production
in India, respectively. Egg production in Bihar has shown an annual average growth rate of 6.3 percent from 2000/01 to 2007/08, albeit from a small base.

A number of national and regional players are also trying to set up starch and feed industry in the state, thus integrating the value chain for this crop. Apart from the domestic demand, states in South India such as Andhra Pradesh, Tamil Nadu, and others, and the neighboring state of West Bengal have huge maize demand. A qualitative change has been made in the procurement of maize from the state with the replacement of few monopolistic traders with national players and multinational companies. As a result, the differential (the spot market price minus the market support price) has increased from Rs 100 to Rs 1,600/mt leading to higher farmgate price realization for the farmers (Gupta 2010). Establishing good-quality feed plants within the state can further increase and stabilize the demand and ensure higher margins along the entire chain.

6. Policy Imperatives
Bihar’s GSDP increased at 9 percent per year between 2004/05 and 2009/10, and yet the head-count ratio did not decline from a high 55 percent. With more than 600 poor people/km², Bihar harbors the highest concentration of rural poverty in the world. The impressive growth in the state’s economy has failed to make any dent in poverty because even as the overall economy grew rapidly, agriculture remained stagnant. Rapid growth in agriculture is essential for poverty reduction when 90 percent people in Bihar still live in villages and 81 percent of the workforce reports agriculture as main source of income.

The government of Bihar has been making serious efforts to jump-start agricultural growth. The state’s planned expenditure on agriculture has increased from Rs 0.25 billion in 2004/05 to Rs 8.44 billion in 2011/12—a thirtyfold increase. Bihar became the first state in India to constitute an agriculture cabinet with ministers from 17 departments to improve coordination in the government in implementation of agricultural projects. At the grassroots level, agricultural extension workers called krishi-mitrás (farmers’ friends) have been hired in all panchayats of the state to bring new technologies and practices to farmers. The state government is offering generous subsidies on farm implements (tractors, power tillers, harvesters, pump sets, and others)
and quality seeds and has simplified the process of accessing these subsidies. About 57,000 kilometers of new roads were built between March 2004 and March 2011, raising road density from 78.41 km to 138.74 km per 100 km² of area, and the quality of existing roads has also improved. Procurement of paddy at a minimum support price has also increased significantly.

All these efforts and investments, however, have failed to unleash agricultural growth in the state. Agricultural productivity remains low and variable. We think this is partly because of no improvement in power availability in the state. The power situation remains grim in rural Bihar. More than half of the villages do not have electricity, and in the other half, supply is poor and unreliable. Rural electrification has to improve in the state to catalyze agrarian dynamism. Investing in improving the rural power supply can be the most effective stimulus plan for the stagnant agrarian economy of the state. Both the state and the center should come together to make it possible before the end of Twelfth Five-Year Plan.

The government of Bihar launched a scheme named Bihar Ground Water Irrigation Scheme (BIGWIS) in 2009/10 to provide a subsidy of 45 percent for installing private tube wells along with pump sets. We think that BIGWIS is unlikely to make much of an impact on Bihar’s agriculture. As several large surveys (like LSMS 1997-98; NSSO 1999; Thorpe et al. 2007) show, almost all of the cultivable land in Bihar has access to irrigation. What Bihar needs is intensification of irrigation and not so much the expansion of it. Intensification will take place only if the variable cost of irrigation comes down. Even with ownership of pump sets, irrigating crops does not become an automatic option for Bihar farmers. With poor electricity, diesel becomes an expensive option for the farmers in Bihar, and they heavily economize on irrigation. The use of diesel pushes the cost of cultivation for farmers in Bihar well higher than their counterparts pay in other states. Rural electrification will make it possible. Providing one-time capital subsidy to small and marginal farmers, along with metered electricity connection at nontrivial tariff rates (thereby keeping subsidy to a minimum), much like the neighboring state of West Bengal (Mukherji et al. 2009), will make irrigation much cheaper than the current option of diesel pumps. Provision of electricity will have several other spin-off effects too, such as investment in cold storages and agro-processing units that will enable farmers to diversify toward high-value perishable crops such as fruits and vegetables.
Fixing the rural power sector will take some time. Meanwhile, the government of Bihar has been providing subsidies on diesel to reduce the cost of cultivation and pull the economics in favor of farmers. However, the take-up of this subsidy has been quite low, even after the state government simplified the procedure to get the money. A survey of 406 diesel pump owners in three villages of the Vaishali District found that only one in five farmers even knew of this subsidy and only 17 of them (4.2 percent) had collected the subsidy. A more recent survey of 240 farmers in 16 villages of Nalanda district shows higher take-up of diesel subsidy. Still, problems persist. The subsidy benefits pump-owners more than water buyers. It is also not clear if the subsidy leads to lower prices in water markets. As a result, there is little evidence of even an indirect effect of the subsidy on many farmers who do not have their own diesel pumps and tenant farmers. Large farmers get higher share of the subsidy than marginal and sub-marginal farmers. The payment of subsidy, even to these large farmers, is often delayed reducing its effectiveness. Given these limitations, the subsidy delivery needs to be improved.

Ownership of land is a key variable and determines the possibility to capitalize on incentives provided by the government. Areas with small and fragmented holdings are hot spots of rural poverty and need immediate policy changes toward consolidation, but it is too complex an issue in Bihar to be sorted out in the near future. The political undertones attached with land reforms would take few, if not several, years to wither away. In such a scenario short-term schemes such as BIGWIS, diesel subsidies, and crop insurance need to be coupled with better implementation mechanisms to incentivize the masses.

Bihar needs to improve its infrastructure to let its farmers bounce to higher levels of output and reap maximum benefits. Learning from the experiences of states like Punjab, Haryana, and very recently Gujarat, which were able to provide good infrastructure for agriculture through innovative policy interventions, will Bihar be able to nurture the seeds of growth that emerged in the first decade of the new millennium? The initial inertia has been overcome; it is now time to put Bihar on the take-off trajectory so as to replicate growth rates of Gujarat and reach productivity levels of Punjab.
References


Bihar, Department of Agriculture. 2008. Road Map for Agriculture and Allied Sectors.


Figure Captions

Figure 2.1 Average annual growth rates of gross state domestic product for agriculture and allied sectors for Bihar since 1994/95

Figure 2.2 Per capita Net state domestic product (NSDP)—agriculture at 1993-94 constant prices in Bihar, 1960–2006

Figure 3.1 Percentage share of major sectors to total value of output from agriculture and allied activities in Bihar and India, TE 2008/09

Figure 3.2 Gross cropped area in north and south Bihar, 1966–2005

Figure 3.3 Area, production, and productivity of total vegetables in Bihar, 2000/01 to 2007/08 (area in lakh hectares, production in lakh tones, and productivity in tons per ha)

Figure 3.4 Increase in use of chemical fertilizers (NPK) in Bihar, 1993/94 to 2010/11

Figure 4.1 Liters of diesel that could be purchased by selling one quintal of wheat and paddy

Figure 4.2 Map of Bihar showing areas liable to flooding

Figure 4.3 Overview of the major floods in Bihar since 1990

Figure 5.1 Milk procurement of Bihar State Milk Co-operative Federation Limited -

Figure 5.2 Area, production, and yield of winter maize in Bihar, 2000/01 to 2007/08