Making rapid strides: sources and drivers of agricultural growth in Uttar Pradesh, India

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Abstract: Agricultural sector continues to play a crucial role for economic development, especially in low-income countries like India where the sector is large both in terms of aggregate income and total labour force. This paper aims to identify the key sources and drivers of agriculture growth in Uttar Pradesh, the largest food producing state of India. The study is conducted as a quantitative time-series analysis for the period 1990–1991 to 2014–2015 using simple least square method ($p \leq 0.05$). Although, the volatility of agriculture represented in terms of coefficient of variation is low in Uttar Pradesh in comparison to the national average, yet the growth of gross domestic product from agriculture (GDPA) has been low. The agricultural economy of Uttar Pradesh continues to be dominated by cereals with around 60% of its gross cropped area under cereal crops. The results of regression analysis indicate that better rainfall, irrigation facilities, favourable terms of trade, road development and fertiliser use played an important role to improve agriculture growth in the state. The paper offers a perspective for policy formulation which may be of interest to development scholars and policy-makers.

Keywords: India; agricultural sector; source of agricultural production; key drivers; government policy; development.


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1 Introduction

The role of agriculture in stir up economic growth has been widely recognised by economists worldwide. Among their studies, this includes the seminal work of Bairoch (1973) on Europe, Ohkawa and Rosovsky (1964) on Japan, Dobb (1966) on the Soviet Union, and Johnston and Kilby (1975) on Taiwan and South Korea (de Janvry and Sadoulet, 1989). Similarly, a large segment of the work on this issue coincided with the debate on the role of agriculture in promoting economic development in low-income...
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countries. In this connection, fundamental contributions were made by Lewis (1958), Johnston and Mellor (1961), Schultz (1964), Jorgenson (1969), Fei and Ranis (1964), Lele and Mellor (1981) and Adelman (1984), each stressing different aspects of the relationship between agriculture and industry. In a separate stream of thought, agricultural economists have addressed the issue of the sources of agricultural growth includes the studies of technological change by Hayami and Ruttan (1985), land tenure by Dorner (1972), and price policy by the World Bank (1986). Rarely have significant studies been studied in the sense of tracing the sources and drivers of agricultural growth in a developing country like India and more especially at disaggregated level, which is one of the agriculture-base export economies across the world.

India ranks second in the world in agricultural sector only just after China. With a population approaching almost 1.3 billion in 2016, it is likely to be the most populous country on this planet by 2030 with 1.6 billion people (Chen and Ravallion, 2008; Nandakumar et al., 2010). To feed the growing population, the country will require 310 million tons of food grains, 103 million tons of fruits, and 192 million tons of vegetables (Joshi and Kumar, 2011). Also, the country now accounts for more than 17.5% of the global population and 25.7% poor living below poverty line (Government of India, 2014). Therefore, agriculture sector ensures food and nutrition security who faces increasing challenges of food security with ongoing population growth, one of the challenging tasks in front of researchers and policy-makers. Prior studies have also proven from the experience of other countries that rapid agricultural growth is critical for reducing poverty and malnutrition (World Development Report, 2008; Gulati et al., 2012). The country is facing two types of challenges related to agriculture: the first is low productivity, thus by increasing property rights, R&D for seeds and inputs, irrigation, fertiliser, agricultural extension, credit, rural infrastructure, storage, and connection to markets agriculture production and productivity can be increased. The second problem is the volatility of food prices, often because of events outside the control of poor countries (Dethier and Effenberger, 2012). In this way, enhancing agricultural productivity in sustainable manner, exploiting the untapped potential of resources and using drivers of agricultural growth, the country can play on the world agricultural market to satiate domestic demand. Also, research on this issue is crucial because it could help policy-makers acquire a better understanding of the potential impact of investments in agriculture on the overall economy.

In this paper, we identify the sources and drivers of agricultural growth in Uttar Pradesh, stands fifth in order of area and first in order of population among the states of India, and where 59% of its workforce is engaged in agriculture (Kumari, 2015). It is lying in the Gangetic plain which consists of a vast level expanse of alluvium which is very fertile for its soil, enriched by the alluvial deposits of both the rivers. Agriculture here is relatively secure since the Doab districts are well supplied with canal and tube-well irrigation facilities (Shafi, 1960; Kumari, 2016). However, the state is suffering with low level of landholding as the average size of holding is only 0.76 hectares with 92% of holding being small and marginal (Directorate of Economics and Statistics, GoI). Despite all, agriculture continues to be a key sector of the state’s economy because of its strategic importance to food security, employment opportunities and its critical role in alleviating rural poverty. Uttar Pradesh is the largest foodgrain producing state of India, contributing more than 50.4 million tonnes of foodgrain (about one-fifth of country’s foodgrain production) and major producing state of wheat (31%) and rice (13%) of the total
production of the country. However, Uttar Pradesh achieved only 3.2% agricultural growth from 2005–2006 to 2014–2015 at constant prices 2004–2005, much below than the neighbouring state of Madhya Pradesh which achieved a growth rate of 9.6% in the same period. Against this backdrop, to meet the challenge of reducing rural poverty and increasing the income of farmers, the state should raise the productivity by better utilising its abundant land and water resources. It is, therefore, useful to look at the sources and drivers of agriculture growth at more disaggregated level so that proper policy can be formulated.

The rest of the paper is organised as follow. Section 2 presents an overview of literature to date on sources and drivers of agriculture in Uttar Pradesh. Section 3 reports database and methodology, Section 4 deals with important sources and drivers of agricultural growth, which is analysed using regression analysis to capture the coefficient of each variable and their significance. Section 5 gives conclusion and policy suggestions.

2 Review of literature

There are a handful of studies that have previously dealt with sources and drivers of agriculture growth in Uttar Pradesh, India. A majority of these studies were conducted at the national level, while a few studies also exist at the disaggregated level. Among these, some studies focus on the aggregate agriculture sector in the states, while others study sources and drivers in a very narrow sense. We discuss selected studies below.

It is well documented in the literature that growth in area was the major source of production growth until early 1960s (Bhalla and Singh, 2001; Vaidyanathan, 1992; Kannan and Sundaram, 2011). While, recent studies find agricultural diversification is one of the several pathways of agricultural development. Joshi et al. (2006) examined that agricultural diversification towards high-value crops and output prices were the important sources of growth in agriculture during the decade of 1990s, the period of economic reform. In another study Birthal et al. (2013) argue that the sources of agricultural growth are varied widely across the regions while the irrigated northern region followed a technology-led growth trajectory, the rainfed western and southern regions followed diversification towards high-value crops as the main strategy to enhance and sustain agricultural growth. Rising demand for high-value food products such as fruits, vegetables, milk, meat and fish rapidly in the domestic as well as global markets, diversification can increase the value of agricultural production (Kumar et al., 2003; Aksoy, 2005). The Government has also identified horticultural crops as a means of diversifying agriculture, through efficient land use and optimum utilisation of agro-climate resources and as a way to create employment for rural inhabitants (Sidhu, 2005).

A broad spectrum of the literature analyses the drivers of agriculture growth in Uttar Pradesh. According to Bhalla and Chadha (1983) in Uttar Pradesh, the nature and extent of change were limited because of the insufficient irrigation confined to a few areas and the old land relation, which created a strong barrier to the full exploitation for the benefit of new technology. Many studies stated that irrigation increases the land use intensity, cropping intensity, and provides incentives to farmers to invest in yield increasing inputs, and thus results in higher agricultural output (Dhawan, 1988; Shah, 1993; Vaidyanathan, 1999; Narayanamoorthy and Deshpande, 2005). Many studies report rural–urban
linkages through road development which also helps in improved backward and forward linkages in agricultural sector. Rural roads increase the diffusion of agricultural technology by improving access of farmers to markets, enhance more efficient allocation of resources, reduce the transaction costs and help the farmers to realise better input and output prices (Ahmed and Donovan, 1992; van de Walle and Cratty, 2002). Another important input driver of agriculture growth is energy consumption, serves as a proxy for a country’s physical infrastructure development, which helps in agricultural production (Mohan, 2006). Also, rural electrification increases the energisation of pumpsets, which helps in increasing the irrigated area using groundwater; the output of crops cultivated by underground water is generally higher than canal or tank irrigation, because of its better reliability and controllability (Barnes and Binswanger, 1986; Dhawan, 1988; Vaidyanathan et al., 1994; Shah et al., 2006). Studies report that capital formation in agriculture by both sectors, public and private, is a major source of growth in agriculture, for example Gulati and Batla (2001) examined that physical and financial factors affected the private investment in agriculture. Some studies report average institutional credit per hectare cultivated area as a proxy of credit flow which increase the agricultural productivity (Murthy et al., 2009; Biradar, 2013). Many factors adversely affect farmer lending operations of bank, for example lack of rural infrastructure, lack of coordination between bank and bank on the one hand and between banks and government district level development departments on the other, lack of up-to-date land records and other related requirements, etc. (Akoijam, 2012). Apart from these, the use of quality seed and planting material appears to be the most effective tool to enhance agriculture growth and productivity (Kumar and Ali, 2010).

Despite the plethora of literature on sources and drivers of agriculture growth, gaps remain in identifying the prevailing heterogeneous in fluencies in Uttar Pradesh that drive agri-growth. Therefore, the present study tries to fill this gap.

3 Data and methodology

The study relies on secondary data compiled from various published sources. Data on area, production and yield are taken from the Directorate of Economics and Statistics (DES), Ministry of Agriculture, Government of India (GoI). The study covers the period from 1990–1991 to 2014–2015. It is noted that time series data have a common tendency of growing over time. Therefore, as a robustness check we use Augmented Dickey–Fuller (ADF) test and then we use the Engle–Granger Test for Cointegration to test for long-term relationship between the selected variables. Data on value of crop output have been compiled from the Central Statistical Organisation. For trend analysis, three years average (triennium ending) of different crop and input variables were calculated to even out the inter-year fluctuations. To analyse the composition of agriculture, we have computed the share of the value of output from different segments as a percentage of the total value of output from agriculture and allied activities at current prices.

The performance of agricultural growth is influenced by many factors such as the use of physical inputs by farmers, irrigation, credit availability, subsidy, weather conditions and Government policies. Kannan and Sundaram (2011) have used neoclassical growth model to examine the determinants of aggregate growth of crop. Therefore, the study has
used selected indicators, for example rainfall, technology (fertiliser use), infrastructure (irrigation ratio, road density), incentives (terms of trade) affect the growth of agriculture. The model is specified as:

\[ Y_t = \beta_0 + \beta_1 \ln \text{rain} + \beta_2 \ln \text{gdp\_deflator} + \beta_3 \ln \text{road} + \beta_4 \ln \text{fertiliser} + \mu, \]  

(i)

\[ Y_t = \beta_0 + \beta_1 \ln \text{irri} + \beta_2 \ln \text{gdp\_deflator} + \beta_3 \ln \text{road} + \beta_4 \ln \text{fertiliser} + \mu, \]  

(ii)

where \( Y_t \) is gross state domestic product from agriculture and allied activities at (2004–2005) real prices, \( \ln \text{rain} \) is rainfall intensity, \( \ln \text{irri} \) is irrigation ratio, \( \ln \text{gdp\_deflator} \) is terms of trade, \( \ln \text{road} \) is road density per 100 sq. km of population, \( \ln \text{fertiliser} \) is fertiliser use per hectare/kg.

4 Results and discussion

Although the contribution of the agriculture sector in Uttar Pradesh’s income has been declining, still around 59.2% of the workforce is dependent on agriculture and allied activities which show this sector is still playing a predominant role in the state’s economy. In Uttar Pradesh, the share of GDP from agriculture at real prices declined from 30.5% in TE 2002–2003 to 22.6% in TE 2013–2014, which shows diversification of economy from farm to non-farm sector. However, the share of GDP from agriculture at all India level has declined at a much faster rate from 30% to 14.1%. The share of state’s rural labour force employed in agriculture was 63.7% in Uttar Pradesh against the national average of 64.1% in 2011–2012. In this context, it is important to critically examine the previous growth performance of agriculture and assess future prospect of growth in the state. From Table 1, we find that total geographical area of Uttar Pradesh is 24.3 million hectares (which is 7.4% of the total area of the country). However, due to high population density the Gross Cropped Area (GCA) per 100 persons in Uttar Pradesh is 12.7 per hundred persons much lower than Madhya Pradesh (31), Gujarat (21) and Punjab (28) in TE 2012–2013 (Figure 1).

**Figure 1** Gross cropped area and gross irrigated area per 100 persons (in ha) in TE 2012–2013

![Figure 1](image)

*Source: Directorate of Economics & Statistics*
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<table>
<thead>
<tr>
<th>Indicators</th>
<th>Uttar Pradesh</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical area (million hectares)</td>
<td>24.3</td>
<td>328.0</td>
</tr>
<tr>
<td>% of total geographical area</td>
<td>7.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Gross cropped area per 100 persons in TE 2012–2013</td>
<td>12.7</td>
<td>15.9</td>
</tr>
<tr>
<td>% of gross cropped area</td>
<td>13.2%</td>
<td>100.0</td>
</tr>
<tr>
<td>Cropping intensity</td>
<td>155.4</td>
<td>139.1</td>
</tr>
<tr>
<td>Gross irrigated area (in million hectares) in TE 2012–2013 (parenthesis gives irrigation ratio)</td>
<td>19.9 (77.2%)</td>
<td>91.1 (46.5%)</td>
</tr>
<tr>
<td>Projected population 2016 based on census 2011 (in millions)</td>
<td>217.3</td>
<td>1305.6</td>
</tr>
<tr>
<td>% of India’s population</td>
<td>16.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Rural population (%)</td>
<td>77.7</td>
<td>68.8</td>
</tr>
<tr>
<td>Population density (persons/Km²)</td>
<td>894</td>
<td>398</td>
</tr>
<tr>
<td>Rural poverty (%) (parenthesis gives poverty ratio for 2004–2005)</td>
<td>30.4 (42.7%)</td>
<td>25.7 (37.2%)</td>
</tr>
<tr>
<td>Agricultural growth from 2005–2006 to 2014–2015</td>
<td>3.2</td>
<td>3.6</td>
</tr>
<tr>
<td>No. of districts</td>
<td>75</td>
<td>676</td>
</tr>
</tbody>
</table>

Note: Rural population and population density are projected for 2016 based on Census 2011.

Source: Census of India, 2011, Directorate of Economics and Statistics and National Sample Survey data

4.1 Trends in agriculture growth

In 11th Five year plan (2007–2012), Uttar Pradesh achieved only 3% growth against the planned 4% for agriculture sector. The New State Agricultural Policy-2013 aims to transform the state into a ‘Granary of the Nation’ by ensuring food and nutritional security and to improve the quality of village life with inclusive and sustainable growth. The policy targets 5.1% growth in the agriculture sector in the 12th Five year plan (2012–2017). However, from 2000–2001 to 2014–2015, the annual average growth of agriculture GDP in Uttar Pradesh was 2.4% per annum, which was lower than the all India average growth rate of 3.2% per annum. Similarly, the growth of agriculture GDP in Uttar Pradesh has declined in the years 2004–2005 and 2009–2010 drastically (Figure 2). Also, in the last ten years (from 2005–2006 to 2014–2015), the growth rate of agriculture in the state has been at 3.2% lower than the all India growth rate of 3.7%, much lower than other agricultural-base states. The low and declining growth of agriculture was caused mainly due to successive natural calamities, e.g. drought in 2002, 2004, 2007, 2009 and 2014 especially in the eastern region of the state. In 2000, 2007 and 2016, the state experienced a severe floods situation and many districts of eastern region crops were badly damaged.
Figure 2  State-wise agri-GDP growth between 2005–2006 and 2014–2015 (at constant prices 2004–2005) (see online version for colours)

Note:  The data for all states, except Gujarat, Kerala and Himachal Pradesh, are till 2014–2015.
Source:  CSO, Government of India

4.2 Composition and sources of agricultural growth

The sources of agricultural growth have varied extensively across the Indian states. It is observed that the irrigated northern India states have a technology-led growth trajectory, while the western and southern regions of India experienced diversification towards high-value crops as the main strategy to enhance and sustain agricultural growth (Birthal et al., 2013). Therefore, this section identifies the composition and sources of agricultural growth in Uttar Pradesh.

4.2.1 Foodgrains and non-foodgrain segment

Uttar Pradesh is the largest foodgrain producing state of India. The total foodgrain production has increased from 41.7 million tonnes in TE 2002–2003 to 46.8 million tonnes in TE 2014–2015, an increase of around 37%. In foodgrain production, cereals – mainly rice and wheat – dominate the cropping pattern; also their share in the GCA has increased, while share in the total value of output at real prices has declined continuously. The share in terms of value of output of foodgrain has declined from 34.1% in TE 2003–2004 to 27.7% in TE 2013–2014 (Figure 3). Livestock and sugarcane are the major source of agricultural income of Uttar Pradesh, which share 29.7% and 27.7%, respectively in TE 2013–2014, higher than the share of all India in the same year.
Figure 3  Sector-wise shares in total value of output from agriculture and allied activities (at current prices)

Source: Ministry of Statistics and Programme Implementation, Government of India

4.2.2 Procurement of foodgrains

Although Uttar Pradesh is the top performing state of India in foodgrain production, yet the procurement of wheat and rice has been very low. In the state, procurement of wheat was only 10.2% of the total production in TE 2013–2014 which is much lower than the procurement in Punjab and Madhya Pradesh of around 75% and 52.7%, respectively, of their wheat production. It is important to note that the percentage of rice procurement to total rice production of Uttar Pradesh has declined from 25.7% in TE 2005–2006 to 15.7% in TE 2013–2014. Haryana, Madhya Pradesh and Punjab procure more than two-third of the market surplus of wheat. The major wheat producing states are Uttar Pradesh, Haryana, Madhya Pradesh and Punjab, which accounted for almost 75% of the total production of wheat in the country in TE 2013–2014. The procurement of wheat as a percentage of market surplus in Uttar Pradesh is only 13%, while it is much higher in Punjab (81%), Haryana (71%) and Madhya Pradesh (67%) (Figure 4). In the last decade, Government of Madhya Pradesh has geared up its procurement machinery as a result of which the wheat procurement in the state reached a peak of 8.5 million tonnes in 2012–2013. The Government of Madhya Pradesh has introduced the new digital system of e-Uparjan in the year 2011–2012 that ensures transparency and speedy payment of MSP to farmers. Farmers can register for free, following which SMSs are sent to them to facilitate arrangement at the centres where wheat is procured and payment is then made directly into their bank accounts. The procurement target of wheat for state Government of Uttar Pradesh during Rabi marketing season 2015–2016 is 30.00 lakh MT. In Uttar Pradesh, total 5112 wheat purchase centres have been opened in the state out of which 4972 are operated by state Agencies and 140 by Food Corporation of India (FCI).
To examine the effectiveness of MSP operations for paddy and wheat producers, the difference between their farm harvest price (FHP) and MSP was calculated from 2001–2002 to 2013–2014. It has been observed that FHP ruled lower than the minimum support price MSP in Uttar Pradesh consistently from 2007–2008 to 2013–2014. However, in case of paddy it fluctuated in all the time from 2001–2002 to 2013–2014. The average price difference between the MSP and FHP for the period 2008–2009 to 2013–2014 for paddy and wheat was 3% and 7.6%, respectively (Figure 5). In Uttar Pradesh, the low procurement to marketable surplus ratio has affected the FHP of paddy and wheat. One would have been under the impression that this state would benefit more from the price policy than others due to its higher level of production and better road infrastructure. However, the price behaviour reveals that on numerous occasions the price policy failed to ensure that the farmers got at least the MSP for their paddy and wheat. It was because the production in the absolute sense was very high, but the proportion of the produce procured was low. Despite low per capita per day availability of rice, the private trade appeared to prevent price signals to reach the market and through collusion, forced the prices to prevail, even lower than MSP in the environment of non-intervention in the market by Government procurement agencies. The price policy is considered to be ineffective for the producer as the state Government has less interest in procurement operations due to small marketable surpluses and failure of the agricultural market. Therefore, the farmers of the state incur a loss on account of receiving lower FHP than MSP. Also the market arrivals of wheat and rice in Uttar Pradesh are only 14.2% and 23.6%, respectively, to its total production in TE 2014–2015.

**Figure 4** Procurement of wheat as a percentage of market surplus (TE 2013–2014)  
(see online version for colours)

<table>
<thead>
<tr>
<th>State</th>
<th>Procurement</th>
</tr>
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<tbody>
<tr>
<td>Punjab</td>
<td>81</td>
</tr>
<tr>
<td>Haryana</td>
<td>74</td>
</tr>
<tr>
<td>MP</td>
<td>67</td>
</tr>
<tr>
<td>India</td>
<td>45</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>31</td>
</tr>
<tr>
<td>Bihar</td>
<td>19</td>
</tr>
<tr>
<td>UP</td>
<td>13</td>
</tr>
</tbody>
</table>

*Source:* Department of Food and Public Distribution and DES

To strengthen the supply chain from farm gate to the market in the Union Budget 2010–2011, GoI identified that Eastern region of India has the ample potential for increasing productivity of crops, particularly wheat and paddy, and launched a scheme called ‘Bringing Green Revolution in Eastern India (BGREI)’. The scheme was launched in seven states of eastern India, namely: Bihar, Chhattisgarh, Jharkhand, Eastern Uttar Pradesh, Odisha and West Bengal based on strategic action plans developed by these
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states as a sub-scheme of Rastriya Krishi Vikas Yojana with active involvement of gram sabha. The average five years productivity difference between pre- and post-BGREI of rice has been presented in Table A1 (see Appendix). In figure it can be seen that the productivity of rice has increased in eastern districts of Uttar Pradesh which come under this scheme. Also productivity of wheat has increased in five selected districts of Eastern Uttar Pradesh in this period, namely Ambedkar Nagar, Maharajganj, Siddarhnagar, Sant Ravidasnagar and Sultanpur.

Figure 5  Difference between farm harvest price and minimum support price of paddy and wheat (in Rs.)

Source:  Directorate of Economic and Statistics and Commission for Agricultural Cost and Price

4.2.3 Sugarcane

Sugarcane is the most important cash crop of Uttar Pradesh and sugar industry in the state has been a focal point for socio-economic development in the rural areas by mobilising rural resources, generating employment and enhancing farm income. Also, it is the largest sugarcane producing state of India, which account 37.6% share in overall sugarcane production in TE 2013–2014 with 8.2% of its GCA. The state is the top producer of sugarcane traditionally, but it lost its top slot of sugar producing state of Maharashtra due to the relatively larger capacity of mills and higher productivity of cane partially due to the high recovery rate in Maharashtra and relatively higher diversion of cane to khandsari and gur production in Uttar Pradesh. The production of sugarcane in the state has increased from 115 million tonnes in TE 2002–2003 to 133.4 million tonnes in TE 2014–2015. The sugarcane productivity in Uttar Pradesh is low at 60 tonnes per hectare, which was lower than the all India average of 70.1 tonnes per hectare in TE 2014–2015. In Uttar Pradesh, major sugarcane producing districts are Muzaffarnagar, Bijnor and Kheri which produce 34% of total sugarcane production in the state. Recent data show that 116 sugar mills have produced 36.15 lakh tonnes of sugar in till January 2016, as compared to 33.75 lakh tonnes produced by 117 sugar mills last year. This implies that production of sugarcane has increased while productivity and share of value
in agriculture has declined over time. In Uttar Pradesh, the share of sugarcane in total value of agricultural output has increased marginally from 12% in TE 2003–2004 to 12.8% in TE 2014–2015, due to the low sugar prices in the market and increasing demand for other high-value items like fruits, vegetables and livestock segments.

It is well-known fact that sugarcane is a high water-consuming crop and about 80% of its water requirement is met through groundwater. The higher irrigation ratio has had positive effects in that it has helped to increase in sugarcane production in the state. In Uttar Pradesh, the distribution of the irrigated area under sugarcane is skewed as it is high in the western and eastern regions while low in the central and Bundelkhand regions. Also, the state’s cane pricing policy is considered responsible for losses incurred by sugar mills in the last three years as the state Government fixes a high state advised price (SAP) than the fair and remunerative price (FRP) fixed by state Government. Therefore, the sugar mills in Uttar Pradesh have been paying much higher prices for sugarcane, leading to higher cost of production as compared to the other two large sugar producing states of Maharashtra and Karnataka. This has made them somewhat less competitive within the domestic market too.

4.2.4 Fruits and vegetables

Diversification from foodgrains to high value crops in Uttar Pradesh has been slower than other states. In the state, a majority of farmers have small and marginal landholding (80%) and their income from crop cultivation is not enough to meet their subsistence level; therefore, diversification from cereals to horticulture may be a great reform of increasing farmer’s income. Uttar Pradesh with its variability of climate and soil produces a large range of horticultural crops such as fruits, vegetables, mushrooms, flowers, medicinal and aromatic plants, spices, bee-keeping, etc., has also taken off on a large scale. The area under fruits and vegetables in Uttar Pradesh in TE 2012–2013 was 4.2% of GCA, lower than the all India average of 4.9%. There has, however, been a decline in the share of value of fruits and vegetable from 13.7% in TE 2003–2004 to 8.9% in TE 2013–2014 in Uttar Pradesh. The share of value of livestock at all India level has, however, increased from 27.3% in TE 2003–2004 to 29.7% in TE 2013–2014. In Uttar Pradesh also, it has increased from 25% in TE 2003–2004 to 29.7% in TE 2013–2014.

The share in the total horticultural production of Uttar Pradesh is about 26% in the country’s production, second largest producer (after West Bengal) of vegetables and seventh largest producer of fruits. The total production of fruits was 3.4 million tonnes from 0.3 million hectares during the TE 2007–2008. It increased to 5.8 million tonnes in TE 2014–2015; however, the area remained the same. Uttar Pradesh is the largest mango producing state of India and about 24.6% of the country’s production was in Uttar Pradesh in TE 2014–2015. The state ranks second in guava production after Madhya Pradesh and shared about 19.4% of the all India production in TE 2014–2015. The state contributed 7.3% fruits production and productivity of fruits is much higher at 18.1 tonnes per hectare than the all India productivity level of 12.7 tonnes per hectare. Also, the productivity of fruits in Uttar Pradesh has increased from 11.4 tonnes per hectare in TE 2007–2008 to 18.1 tonnes per hectare in TE 2014–2015. Uttar Pradesh is a leading producer of amla in the country and produces 29.3% of the total production of the country in TE 2014–2015.
Uttar Pradesh is the second largest vegetable producing state of India just after West Bengal. It is the largest potato and peas producing state. The state produces 33% of the country’s potato and 45% of peas. Productivity of vegetables has, however, gone down from 20.6 tonnes per hectare in TE 2009–2010 to 17.1 tonnes per hectare in TE 2013–2014. The increase in production of potato has been significant as the total production increased from 11.8 million tonnes in TE 2009–2010 to 14.1 million tonnes in TE 2014–2015. Nevertheless, the share of fruits and vegetable in the total value of output from agriculture and allied activities has declined from 13.7% in TE 2003–2004 to 8.9% in 2013–2014. It is important to note that despite being endowed with diverse agro-climatic conditions, degree of agricultural diversification is much less in Uttar Pradesh due to absence of value chain linking agricultural markets and consumers. The horticultural crops, particularly vegetables, are more labour intensive.

In order to break the monopoly of middlemen/traders, provide maximum benefit to the farmers and quality at reduced cost to consumers, the Government launched National Agricultural Market (e-NAM) on 14 April 2016 in 21 mandies across eight states, namely Gujarat, Rajasthan, Haryana, Uttar Pradesh, Madhya Pradesh, Jharkhand, Himachal Pradesh and Telangana. Subsequently, two more mandies from Haryana have been integrated with e-NAM. For integration with e-NAM, states are required to complete certain prerequisite reforms in their respective Agriculture Produce Marketing (Regulation) Acts to provide for (i) a single license to be valid across the state, (ii) single point levy of market fee, and (iii) provision for electronic auction as a mode of price discovery. Under the scheme, the Central Government is providing software free of cost and a grant up to Rs. 30 lakh per mandi for related infrastructure/equipments including equipment. As on 14 April 2016 e-NAM has been used for trading of 51 commodities which total quantity traded is 0.26 million tonnes. The valued of agri-commodities traded has reached to Rs. 124.8 crore and total number of registered users under e-NAM in the whole country has touched to 28,929 farmers and 2866 traders up to 31 July 2016. e-NAM is expected to benefit the farmers through enhanced market access by way of allowing online bidding for their produce, removal of information asymmetry between buyers and sellers, real-time price auction, uniform marketing procedures, payment according to quality of produce and most importantly online payment directly into farmer’s account.

4.2.5 Livestock sector

The livestock sector not only provides essential proteins and nutritious human diet through milk, eggs, meat, etc., but also plays an important role in utilisation of non-edible agricultural by-products and waste. It is an important option for diversification of agriculture in Uttar Pradesh. According to the Livestock Census 2012, the livestock population in Uttar Pradesh was the highest in the country, viz. number of milch animals (cows and buffaloes) was 18.4% of the all India milch population. Also milch population has increased from 1.85 crore to 2.45 crore between 2007 and 2012, an increase of CAGR 7.3% (Figure 6).
Dairy sector is one of the most important sources of earning for the population in the rural area. Uttar Pradesh is the largest milk producing state of India, accounting for more than 17.4% of the total milk production of the country in TE 2013–2014 (Figure 7). Milk production in the state has increased from 14.6 million tonnes in TE 2002–2003 to 23.4 million tonnes in TE 2014–2015, an increase of 4.1%. The growth rate of milk in the neighbouring state of Bihar was, however, around 8.6% much higher than the growth rate of Uttar Pradesh and all India of average 4.3% in the same period. Within agriculture and allied sectors, the share of the value of milk in Uttar Pradesh has increased slightly to 22.8% from 21% from TE 2003–2004 to TE 2013–2014. Although the contribution of Uttar Pradesh to all India output of milk and meat has been increasing, however, within the livestock sector, there has been a gradual shift towards meat production in the state. Relatively lower and unstable prices of milk were perhaps responsible for lower growth rate of the milk sector in Uttar Pradesh. It is quite clear that the procurement system of milk has failed to provide suitable prices to the farmers. The private market of milk has not been able to assure stable and fair prices to milk producers. The procurement of milk by cooperatives in Uttar Pradesh is only 1% of total production. The milk price has ranged between Rs. 16–17 per litre and sometimes Rs. 7 per litre in villages in April–May 2014, which is very low in comparison to the other states of India. Also, average yield per animal in milk is lower in Uttar Pradesh (7.08 kg/day) than other states like Punjab (11 kg/day), Kerala (9.1 kg/day), Gujarat (8.8 kg/day) and Haryana (8.1 kg/day).

The state has shown a decline in the number of cooperatives in the villages, from 10,600 district level societies in 2000–2001 to 7300 in 2015–2016. Likewise, the membership of cooperative societies has gone down from 5.41 lakh in 2000–2001 year to 4.01 lakh in 2015–2016. The membership touched a high of 7.73 lakh in 2007–2008. Similarly, the milk procurement by cooperatives has declined from 8.85 lakh kg per day

### Source
Ministry of Statistics and Programme Implementation, Government of India

### Figure 6  Percentage of total value of output from livestock sector
Making rapid strides in 2000–2001 to 4.02 lakh kg per day in the year 2015–2016. The sale of milk has declined from 4.8 lakh litre per day in 2000–2001 to 2.2 lakh litre per day in 2015–2016 (Figure 8).

The Union Government introduced a scheme ‘National Mission for Protein Supplement’ (NMPS) as part of Rashtriya Krishi Vikas Yojna (RKVY) in the year 2011–2012 and 2012–2013 to assist states to produce protein-rich animal products within a limited time frame. The NMPS aimed at providing livelihood and nutritional security to small and marginal farmers and landless labourers. The main activities envisaged include setting up of milch cattle, dairy units, training of farmers, marketing infrastructure and establishment/modernisation of dairies. The scheme was implemented in all the districts under cooperative milk shed in Uttar Pradesh. Milk producers in these regions were given assistance through the village milk cooperative societies.

Figure 7  Milk production and growth rate

![Milk production and growth rate](image)

Source: National Dairy Development Board

Figure 8  Decline in milk sale, procurement and functional cooperative societies

![Decline in milk sale, procurement and functional cooperative societies](image)

Source: PradeshiK Cooperative Dairy Federation Uttar Pradesh
(b) Meat

Uttar Pradesh is the leading state in meat production as it contributes 19.1% to the total meat production of the country. The meat sector contributes around 4% of the total value of output from agriculture and allied activities in Uttar Pradesh in TE 2013–2014. In Uttar Pradesh, the buffalo meat (70.3%), goat meat (18.5%), pig meat (9.5%) and sheep meat (3%) are the main types of meat produced. Uttar Pradesh is the largest buffalo meat producing state of India and it contributed 46.8% of the total production of the country. Out of total Indian carabeef exports, 67% originate in Uttar Pradesh. It is the second largest producer of goat meat in the country (after West Bengal 24.3%) and contributed 18.5% of total goat meat production in TE 2013–2014. The total meat production in Uttar Pradesh has increased by 48.2% from 0.77 lakh tonnes to 1.14 lakh tonnes between 2008–2009 and 2012–2013. As per the report published by FICCI, Uttar Pradesh has 22 export units out of 34 units in the entire country, which shows the acceptability of this sector in that state. Animal census 2012 reports that there were around 68.7 million animals and 17.7 million poultry in the state which is almost 13.4% and 2.6%, respectively, of the all India numbers. Uttar Pradesh showed the second highest increase in livestock population at 14.01% after Gujarat. The domestic value chain for buffalo meat production in Uttar Pradesh consists of a network of stakeholders.

4.3 Determinants of agriculture growth

Agriculture growth in India was spearheaded during the green revolution period with the introduction of new technology, irrigation, use of fertilisers and High Yield Variety (HYV) seeds. Western region of Uttar Pradesh spearheaded a green revolution in the state and saw a substantial increase in productivity of foodgrains. It is, therefore, imperative to study the growth in these inputs over a period of time to get an idea about the process of agricultural development in the state. Thus, in this section we study the determinants of agricultural production in Uttar Pradesh. We will also see the correlation between different input variables and how they are associated with each other and affect agriculture development in the state.

4.3.1 Irrigation facility

Uttar Pradesh is endowed with rich water resources and is bestowed with a vast network of seasonal rivers. The state has a large network of canals which provide irrigation to farmers of alluvial plains in Eastern, Western and the Central regions of Uttar Pradesh. Percentage of Gross Irrigated Area (GIA) to GCA increased from 67.6% in 2000–2001 to 78.2% in 2012–2013. The main source of irrigation is, however, groundwater, viz. 80% of area irrigated in 2011–2012 (net) is sourced from tube wells and wells which is higher than all India average of 62%. High dependence on groundwater irrigation has two implications: (i) excess withdrawal of groundwater, and (ii) in years of poor rainfall, farmers have to spend more on diesel and sometimes the tube wells have to dig even deeper. Another important of irrigation source is canal, but its share in GIA has declined from 21% in TE 2002–2003 to 18.5% in 2011–2012. Also, the GIA across the region in Uttar Pradesh is not evenly distributed. The Western region is highly irrigated with 92% of its GCA covered under irrigation while in Bundelkhand region only 54% is irrigated.
The ultimate irrigation potential (UIP) for the country was assessed to be about 139.9 million hectares out of which 101.7 million hectares of irrigation potential has been created during 2002–2007 (tenth plan). The maximum irrigation potential was created in Uttar Pradesh for 32.4 million hectares. The percentage of irrigation potential created (IPC) to UIP was also highest in Uttar Pradesh at 109.3%, higher than the all India average of 72.7%. Uttar Pradesh has an UIP of 29.6 million hectares, out of which 12.1 million hectares can be irrigated through major and medium projects which require large public investment. This shows that the state has been largely able to utilise its water resources effectively for agricultural production.

4.3.2 Power facility

The share in power consumption for agriculture in Uttar Pradesh has declined from 19.6% in 2000–2001 to 17% in 2012–2013. Under these circumstances, majority of the small and marginal farmers in state are dependent on the high priced diesel-operated pump sets for irrigation. Owing to the high operational cost of diesel engine pump sets and poor economic conditions of farmers, they are not able to optimally use the pump sets for irrigation, especially in the years of poor rainfall during Kharif. Consequently, the average crop yields in the state are lower than their potential.

The shortage and irregularity of power consumption is due to high tariff of power which increase the cost of power unaffordable, especially for the poor farming community in the state. The power tariff of the state has increased from 108 paise kilowatt in 2001–2002 to 192 paise kilowatt in 2011–2012 (Planning Commission, 2013–2014). It is much higher than the all India power tariff of around 16.1 paise kilowatt and 143.7 paise kilowatt in the same periods.

Government of Uttar Pradesh is running a scheme for setting up of surface solar pumps in farmer’s fields. The subsidy is available for pumps of 2 horsepower, 3 horsepower and 5 horsepower. For small and marginal farmers the subsidy is 90%, while the farmer’s contribution is only 10%. In order to encourage group of farmers to install the solar pumps, the Uttar Pradesh Government provides subsidy up to 85%. For all other farmers not covered in these two categories, the subsidy is 65%. The subsidy includes a 30% grant of Ministry of New and Renewable Energy of Government of India.

It is understood that there have been several instances of theft of solar panels and solar pumps from farmer’s fields. In order to address this problem, the state Government has come up with a scheme for providing solar mobile trolleys through Uttar Pradesh State Agro Industrial Development Corporation. In 2016–2017, the budget for solar trolleys is Rs. 33 crores while the budget for solar pumps is Rs. 93 crores.

4.3.3 Roads development

Efficient road infrastructure also enables the consumers to get agricultural produce at reasonable prices. In Uttar Pradesh, rural roads are constructed under several rural development programs of the state and the Centre Government like Mahatma Gandhi National Rural Employment Guarantee Program, Pradhan Mantri Gram Sadak Yojna, Ambedkar Gram Yojna, Farm to Market Road (funded by the World Bank) and Rural Infrastructure Development Fund (RIDF) scheme of NABARD. In Uttar Pradesh, road density is 1810 per 1000 sq. km which is higher than all India average of 1318 per 1000 sq. km in 2013–2014 (Figure 9). Also, surfaced road as percentage of total roads are
higher at 78.7% in comparison with the all India average of 69%. It shows better connectivity in Uttar Pradesh compared to many other states. The state has, however, not being able to provide rural connectivity to all the villages so far and 20% villages still remain unconnected to all weather roads. A number of policy measures for road development in the state have been undertaken by the state Government like Uttar Pradesh Road Development Policy (1998), Guidelines for Build Operate Transfer (BOT) Policy (1998), the establishment of State Road Fund (1998) and Uttar Pradesh State Highway Authority (2004).

**Figure 9** Road density in Uttar Pradesh (in ‘000’ sq. km)

Source: Ministry of Roads, Transports & Highway, Several issues of Basic Road Statistics of India

### 4.3.4 Seeds availability

Seed is a critical input for enhancing agricultural production and productivity in different agro-climatic regions. In Uttar Pradesh, seed replacement rate (SRR) increased for crops, like wheat, paddy and bajra from 2001 to 2009, but after that it has declined. Also, SRR for moong has increased from 20.7% in 2006 to 94.2% in 2008, but it has declined very significantly to 20.8% in 2011. SRR declined for gram after 2009 while for arhar and urad, it has increased. Also SRR is very low for coarse cereals like maize, jowar and bajra which are the major cereal crops in the unirrigated regions of the state particularly Bundelkhand. Declining SRR for foodgrains and pulses may have contributed to the low rate of agricultural growth in the state. The Government of Uttar Pradesh has distributed 53.29 lakh quintals of high-quality certified seed in 2013–2014. Likewise, 50.87 lakh quintals high-quality certified seeds were distributed in 2014–2015. The Government has taken measures to encourage the use of drum seeders for the direct sowing of Paddy. This will increase production and reduce costs. The state has distributed 2800 drum seeders to farmers at 50% subsidised prices in 14 districts in 2014–2015. The Government of Uttar Pradesh has set up 1000 agri-junctions in (five in each block) the state which will not only provide all farm inputs to farmers, but also assist them in bank loans, and help them in availing the agriculture programs of the Uttar Pradesh Government and the Central Governments.
4.3.5 Direct benefit transfer of seed subsidy

Uttar Pradesh has successfully implemented Direct Benefit Transfer (DBT) for seed subsidy to farmers. The program was first tried out for providing subsidy on hybrid seeds in the 2015 Kharif season. This was followed by DBT on all seeds – both certified varieties and hybrids – during Rabi 2015–2016. The DBT program benefited around 1.5 lakh farmers in Kharif 2015. They were given the freedom to buy seeds from any of the designated retail outlets operated by private companies at market prices, with the subsidy being credited separately into their bank accounts. While in the preceding Kharif season (2014), the Uttar Pradesh Government spent more than Rs. 85 crore as subsidy on hybrid paddy, maize, jowar and bajra seeds, the outlets go fell to less than Rs. 25 crore in Kharif 2015 after introduction of DBT. In the Rabi season 2015–16, too, farmers bought wheat, oilseeds and pulses seeds from designated Government/semi-Government and cooperative outlets at market-linked rates. The total subsidy amount, transferred directly into the accounts of approximately nine lakh farmers, came to Rs. 127 crore. This again was lower as compared to a subsidy of Rs. 217 crore incurred during 2014–2015 Rabi.

The DBT portal of the Uttar Pradesh agriculture department was extensively used for disbursal of subsidy on seed purchased by farmers registered with it. For instance, the subsidy on seeds of certified wheat varieties was fixed at Rs. 1400 per quintal in 2015–2016 Rabi season. Farmers could buy these from stores belonging to the agriculture and cooperative departments, Uttar Pradesh State Agro Industrial Corporation, Uttar Pradesh Seed Development Corporation or Kribhco and Iffco at the notified market price of Rs. 3000 per quintal. The subsidy amount was then transferred directly into their bank accounts within 15 days of purchase. The state has transferred subsidy through DBT mode to about five lakh of the 36 lakh farmers enrolled under DBT in Rabi 2015–2016. The Government estimated the total seed subsidy credited through DBT to touch Rs. 175 crore in Rabi 2015–2016. That includes Rs. 161 crore just on 11.5 lakh quintal of wheat seeds and the rest for other Rabi crops like chana (chickpea), matar (field-pea), masur (lentil) and mustard. The total number of farmers benefited from DBT is 8.2 lakh and 7.03 lakh quintal seed subsidy have been supplied up to March 2016 (Table 2).

Table 2

<table>
<thead>
<tr>
<th>Crop</th>
<th>Quantity (in lakh quintals)</th>
<th>No. of farmers (in lakh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>6.67</td>
<td>7.50</td>
</tr>
<tr>
<td>Pulses</td>
<td>0.33</td>
<td>0.51</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>0.01</td>
<td>0.12</td>
</tr>
<tr>
<td>Barley</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Total</td>
<td>7.03</td>
<td>8.17</td>
</tr>
</tbody>
</table>

Source: Presentation of Amit Mohan Prasad on 12 March 2016

4.4 Econometrics analysis of drivers of agriculture growth

In this section econometric analysis of drivers of agriculture growth has been presented. To check the stationarity of time series variables Augmented Dickey–Fuller test has been presented in Table 4. We find that GDPA, irrigation ratio, and road density are integrated
of order 1 at 1 level of significance rainfall, GDP _deflator_ and fertiliser use at 5% level of significance, i.e. they are stationary in the first difference form, I (1). The result shows that in model 1, rainfall, GDP _deflator_, road density and the use of fertiliser have a significant and positive effect on agri-GDP in Uttar Pradesh (Table 3). The four independent variables together explain 95% of variation in agri-GDP for the period 1990–1991 to 2014–2015. In model 1, the coefficients for GDP _deflator_, road density and fertiliser use turned out significant at the 1% level of significance, while the coefficient of rainfall comes out to be significant at 5% level. In model 2, irrigation, GDP _deflator_, road density and fertiliser use these four variables together explain 96% of variation in agri-GDP. In model 2, irrigation and GDP _deflator_ turn out to be significant at 1% level. Overall, the results show that the agriculture growth in terms of agri-GDP faster if the irrigation, terms of trade (defined in terms of GDP deflator) road density and fertiliser use work speedily in Uttar Pradesh. It has been already pointed that Uttar Pradesh is the third highly irrigated state of India after Punjab and Haryana. Irrigation facilities reduce the cost of production by increasing productivity of major crops. It has huge potential to use its water resources in an equitable and efficient way. Besides irrigation, terms of trade (agriculture deflator/industry deflator) had a positive and significant effect on agriculture growth, which indicates that agricultural growth in the state is highly affected by international and national prices. Roads had a great role in facilitating transportation of agriculture produce by linking producer with the market. With better access to the market, farmers can get a good price for their produce, thus resulting in an increase in farmer’s income. The results suggest the need for increasing expenditure on irrigation, providing better price policy and road connectivity in rural area to increase growth in agriculture in the state.

Table 3  Regression results of determinants of agriculture growth in Uttar Pradesh

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln_irrigation</td>
<td>1.637 (5.267)***</td>
<td>0.311</td>
</tr>
<tr>
<td>ln_rain</td>
<td>0.096 (1.905)*</td>
<td>0.050</td>
</tr>
<tr>
<td>GDP_deflator</td>
<td>0.004 (4.012)***</td>
<td>0.001</td>
</tr>
<tr>
<td>ln_road_density</td>
<td>0.158 (2.322)***</td>
<td>0.068</td>
</tr>
<tr>
<td>ln_fertiliser</td>
<td>0.381 (4.003)***</td>
<td>0.095</td>
</tr>
<tr>
<td>Constant</td>
<td>8.683 (6.921)***</td>
<td>1.26</td>
</tr>
</tbody>
</table>

Note: Dependent variable: gross state domestic product from agriculture (2004–2005 prices). Figure in parenthesis are _t_-value.

*** Significant at 1%; ** significant at 5%; * significant at 10%.

Source: Estimated by authors
Table 4  Augmented Dickey–Fuller (ADF) test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Augmented Dickey–Fuller test</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level (t-stat)</td>
<td>First-difference (t-stat)</td>
<td></td>
</tr>
<tr>
<td>ln_irrigation</td>
<td>–1.6</td>
<td>–9.1***</td>
<td></td>
</tr>
<tr>
<td>ln_rain</td>
<td>0.7</td>
<td>–2.96**</td>
<td></td>
</tr>
<tr>
<td>GDP deflator_2</td>
<td>–0.29</td>
<td>–0.93**</td>
<td></td>
</tr>
<tr>
<td>ln_road_density</td>
<td>–2.7</td>
<td>–1.4***</td>
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</tr>
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<td>ln_fertiliser</td>
<td>0.82</td>
<td>–1.9**</td>
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<tr>
<td>ln_GDPA</td>
<td>–1.8*</td>
<td>2.1***</td>
<td></td>
</tr>
</tbody>
</table>

Note:  *** p < 0.01; ** p < 0.05; * p < 0.1.

Source:  Estimated by author

5  Conclusion and policy implications

In Uttar Pradesh, around 80% of farmers have landholding of less than 1 hectare and 30.4% rural population is living below the poverty line. Since 59.4% of the workforce is dependent on agricultural and allied activities, it is crucial that agricultural sector grows at a faster rate. Although the volatility of agriculture represented in terms of coefficient of variation is low in Uttar Pradesh in comparison to the national average, yet the growth of agriculture has been low. From 2005–2006 to 2014–2015, agricultural growth in Uttar Pradesh was 3.2% per annum as compared to the national average of 3.6% per annum. We found that the agricultural economy of Uttar Pradesh continues to be dominated by cereals with around 60% of its GCA under cereal crops. Despite the larger share of rice and wheat in total cereals, the procurement of these crops was very low – it was 15.7% and 10.5%, respectively, of total rice and wheat production in TE 2013–2014. However, the main source of agricultural growth in the state has been livestock, which contributed 38% of total agricultural growth between 2005–2006 to 2010–2011. Within livestock sector, the expansion has come mainly from dairy and meat sectors. Uttar Pradesh has also seen an increase in production of fruits and vegetables and productivity has increased over time. Regression results show that irrigation ratio, terms of trade and road development played an important role in agriculture development in the state. Some of the key policy interventions which need to be considered by Government of Uttar Pradesh are as follows:

**e-NAM**: Uttar Pradesh has taken the lead in participating in e-NAM Project. Six mandies have been sanctioned grant by the GoI for setting up the IT infrastructure so that e-NAM scheme of GoI can be launched in these mandies. The total turnover achieved through electronic trading in these mandies up to 31 July 2016 is Rs. 805.4 lakh. It is possible to substantially increase the participation of mandies in e-NAM. This will not only bring transparency to the marketing operations in mandies, but it will also ensure better price discovery for farmers. In these mandies the transactions of all the agricultural commodities should be undertaken though the e-NAM software.

**Land leasing**: The average size of landholding in Uttar Pradesh is only 0.89 ha. A model land leasing law has been drafted by a Committee set up by NITI Ayog under the Chairmanship of Prof. M. Haque (1996). The efficiency of agricultural operation can be
substantially increased by encouraging leasing of agricultural land. The Government of Uttar Pradesh may consider facilitating legal leasing of land so that the tenant farmers can take more land on lease for cultivation. This will also check concealed tenancy due to which neither the owners of land, nor the tenants want to make any substantial investment in agricultural operations.

Promotion of animal rearing: Uttar Pradesh is the leading state in production of meat as well as export of buffalo meat. According to animal census of 2012, the number of buffalo in Uttar Pradesh was 30.6 million. In the previous census conducted in the year 2007, the number of buffalo was 26.4 million. If there are proper market linkages, the farmers can take to animal rearing in a big way. The Government of India/NABARD has a scheme Central Sector Scheme on Salvaging and Rearing of Male Buffalo Calves under which grant can be given to farmers who have up to 25 animals.

Fisheries: According to NSSO data of 68th round (2011–2012), 67% age of population in Uttar Pradesh are non-vegetarian. There is enormous scope for increasing the production of fish by incentivising the same. There is a large market of fish consumers, which can be easily tapped for increasing the fish production. According to State Fisheries Development Policy-2013, establishment of wholesale and retail fish markets and cold chain linkages has been addressed. Also quality seed production by establishing State Level Fish Brood Bank, Fish Hatcheries and Nurseries has been highlighted.

Agro-Forestry: The farmers of Western Uttar Pradesh have taken to Agro-forestry in a big way by growing popular trees on the boundary of their farms. However, they face problems in obtaining the permission of Forest Department for cutting of trees. Agro-forestry can be a valuable source of increasing the farmers’ income by utilisation of the boundary of their land by growing of trees. However, this is possible only if the permission to cut trees easily available without bureaucratic role. The Government of Uttar Pradesh must bring synergy between Agriculture and Forest Department so that farmers do not face any harassment in cutting the trees grown by them in their fields.

Soil Health Card: Seeking to spur agricultural growth, the Narendra Modi Government had launched a comprehensive plan to provide ‘Soil Health Card’ to all farmers across the country. The card will carry crop-wise recommendations of nutrients/fertilisers required for farms, making it possible for farmers to improve productivity by wisely using inputs. Till 7 July Andhra Pradesh had distributed 16.3 lakh cards followed by Uttar Pradesh that disbursed 47,378, Punjab (27,307), Chhattisgarh (22,570), Telangana (15,171) and Odisha (10,245). A total of 1.2 crores soil health cards have been distributed up to February 2016. The Soil Health Card portal allows for registration for collection of soil samples along with testing in approved labs. The important aspect of the portal is that it not only gives an assessment to a farmer about use of major fertilisers, but also micro-nutrients which are missing in his field and which must be added to a balanced soil.

Market arrivals: Uttar Pradesh is a leading state in wheat and rice production. However, the market arrival of wheat and rice is very low which shows poor linkages between market and farm. The market arrivals of wheat and rice in Uttar Pradesh are only 14.2% and 23.6%, respectively, to its total production in TE 2014–2015. There is a need to establish more connectivity through markets so that farmers can avail the benefit by selling of wheat and rice in markets.

Groundwater conservation: In Uttar Pradesh especially in Western region water is overexploited due to high production of sugarcane and irrigation of sugarcane by tube
Making rapid strides

wells. Thus, 37 blocks are already exploited, 13 blocks are under critical and 88 blocks are under semi-critical condition. There is a need to diversify sugarcane production from Western region to Eastern region of the state. On the other hand, in Eastern Uttar Pradesh, diesel pumpsets are the dominant source of irrigation, but their use is affected by poor supply of power in the villages. Moving from diesel to electricity as a source of energy for irrigation can have significant pro-poor impact in the region. Solar energy can be harnessed effectively to energising the pumpsets in Eastern Uttar Pradesh as electrification of all villages and ensuring a regular supply of electricity may not be achievable in short term.

*Improvement in procurement system:* Procurement of wheat and rice is very low in Uttar Pradesh as only 10.2% and 15.7%, respectively, of production was in TE 2013–2014. In Eastern Uttar Pradesh, farmers do not receive MSP for wheat and rice due to inadequate procurement infrastructure like procurement centres. There is a need for investment in setting up procurement centres and warehouses so that farmers can avail the benefit of MSP. Faster implementation of e-NAM will help the farmers in realising better price for their produce.

*Dairy sector reforms:* Uttar Pradesh produces 17% of milk production, but only 1% milk is procured by cooperatives. The three states – Gujarat, Karnataka and Maharashtra – together produce less than a fifth of the country’s milk, while they procure 60% of total milk procurement in the country. The Uttar Pradesh Government-owned *Pradeshik Cooperative Development Dairy Federation Limited* (PCDDF), which processes milk and markets its products with the brand name Parag, is also plans to set up a dairy plant of 5 lakh litre daily capacity near Lucknow. The Government of Uttar Pradesh should set up more dairy plants in major cities in the state. The state Government should encourage cooperatives to procure more milk from farmers. The private sector should also be given incentives to directly procure from farmers as value added milk products need large investments and cooperatives may not be in a position to raise such large resources without Government assistance.

*Flood control and disaster management program:* In Uttar Pradesh, 40% areas of eastern region suffer from floods. There is a need to increase financing for improvement of drainage, forestation, embankment construction, building reservoirs, detention basins and rainwater harvesting in these areas, etc.

References


Fei, J. and Ranis, G. (1964) *Development of the Labor Surplus Economy*, Irwin, Homewood, IL.


Appendix

Table A1  Productivity of rice and wheat during pre- and post-Bringing Green Revolution in Eastern India

<table>
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<tr>
<td>Siddarth Nagar</td>
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</tr>
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<td>Sant Ravidasnagar</td>
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<td>Sultanpur</td>
<td>2.7</td>
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Source: Uttar Pradesh Sankhikiya Patrika, Government of Uttar Pradesh