Chapter 6

Performance of Agriculture in Madhya Pradesh

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6.1 Introduction

Madhya Pradesh emerged as the state with the highest growth rate in agriculture. Long clubbed with the so-called BIMARU group of poor northern, central and eastern states, MP successfully broke ranks to set a scorching pace of growth, which has been unparalleled in the past quarter-century. Understanding the factors that helped to drive this growth and drawing lessons for other states at similar levels of development is the main objective of this chapter. Madhya Pradesh's agricultural GDP increased at 8.1% per annum during 2005–06 to 2016–17, surpassing even record holder Gujarat's 6% agricultural growth in the same period. The last three years have been even more spectacular: agricultural GDP increased at 11.8% per annum. Keeping this background in mind, this chapter has used secondary data published by the government to study the composition, sources and drivers of agriculture growth in Madhya Pradesh and the lessons that can be drawn for developing states. Although MP has recorded a significant decline in poverty rates from 53.6% in 2004–05 to 35.7% in 2011–12, there is still much to be done to improve the livelihood of the rural population. Moreover, MP's per capita income is low, standing at Rs. 51,798 per annum (FY14 at current prices) as compared to the national annual average income of Rs. 74,380. Although it is much better than that of Bihar (Rs. 31,199) and Uttar Pradesh (Rs. 36,250), it remains way below top-performing states like Sikkim (Rs. 176,491), Maharashtra (Rs. 114,392), Haryana (Rs. 133,427) and Gujarat (Rs.

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A. Gulati et al. (eds.), *Revitalizing Indian Agriculture and Boosting*

Farmer Incomes, India Studies in Business and Economics,

https://doi.org/10.1007/978-981-15-9335-2_6

106,831). Therefore, the study also makes policy suggestions to bolster agricultural growth in MP.

Among the many measures taken by the state government to make rapid strides in agriculture, three interventions stand out—expanded irrigation, a strong procurement system put in place for wheat along with bonus over MSP for wheat and all-weather roads to connect farmers to markets. Irrigation coverage through tube wells was expanded through the state government’s strategy of initially focusing on providing good quality power supply to farmers during the wheat irrigation season. Canal irrigation, on the other hand, was expanded by utilising financial resources to complete several major and medium irrigation projects that had been under construction for quite a few years. Once irrigation cover expanded for wheat cultivation, acreage and production under the crop increased significantly. Consequently, the government strategised to improve the supply chain of wheat by re-modelling the procurement system through digitisation and initiating “e-*Uparajan*” and by increasing storage capacity significantly. The third important factor that contributed to agricultural growth was the expansion of all-weather roads.

The chapter is organised into three sections as follows:

After a brief Introduction in Sect. 6.1, we provide an overview of the state’s agriculture in detail in Sect. 6.2. In Sect. 6.3, we analyse the composition and sources of agricultural growth in Madhya Pradesh. Section 6.4 presents the econometric analysis to identify the drivers of agricultural growth in the state. Finally, in Sect. 6.5, we present some concluding remarks based on our empirical and econometric analysis and recommend policy prescriptions to sustain high growth in Madhya Pradesh.

6.2 Overview of Agriculture in Madhya Pradesh

Madhya Pradesh (MP), located at the centre of India, is often called the “Heart of India”. It is a landlocked state, surrounded by Uttar Pradesh, Chhattisgarh, Maharashtra, Rajasthan and Gujarat. Until 2000, it was the largest state in the country in terms of geographical area; however, in November 2000, Chhattisgarh was carved out of the south-eastern part of erstwhile Madhya Pradesh. Currently, MP is the second-largest state in India after Rajasthan and it spreads over a geographical area of about 308 lakh ha, which is about 9% of the total area of the country. The average rainfall received by MP is around 95.2 cm during the monsoon season. This accounts for around 91% of the total rainfall in the state. In MP, the eastern parts receive relatively higher monsoon rainfall (105.1 cm) as compared to the western parts (87.6 cm).

Fig. 6.1 Year-on-year agricultural growth in Madhya Pradesh. *Source* MOSPI

6.2.1 Agricultural Growth in Madhya Pradesh

In the recent past, MP has been lauded for its excellent agricultural performance—MP's agricultural GDP increased at 7.5% per annum during 2005–06 to 2018–19. The last three years have been even more remarkable: agricultural GDP grew at 11.5% per annum as compared to the national average of 4.7%. The sector faced instability, but the extent of volatility has declined in recent years. The coefficient of variation for agriculture growth stood at 626% in the period of 2000–01 to 2008–09 and declined to 113% in the period between 2009–10 and 2018–19. In the initial years, agriculture was affected by successive droughts. However, in later years, investment in irrigation enabled the sector to overcome rainfall deficiencies (Fig. 6.1).

6.2.2 Agricultural Livelihood in Madhya Pradesh

According to the 2011 Census, Madhya Pradesh has a population of 72.7 million and the estimated population for 2018 is 82.3 million, which is 6% of India's population. Madhya Pradesh had 54.6% of its workforce engaged in agriculture in 2015–16 (Labour Bureau, 2015–16) while the contribution of agriculture to overall GSDP was 40% in TE 2018–19 (CSO). The agricultural sector is largely dominated by small and marginal farmers. In 2015–16, 75.5% of small and marginal farmers with a holding size of less than 2 ha accounted for 48% of the total area operated. The average size of landholding declined from 2.28 ha in 1995–96 to 1.78 ha in 2010–11 and further to 1.57 ha in 2015–16 (Table 6.1).

Table 6.1 Operational holding in Madhya Pradesh, 1995–96 to 2015–16

	1995–96			2010–11			2015–16		
	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)	Area (%)	Number (%)	Size of holding (ha)
Marginal	8.2	40.4	0.46	12.1	43.9	0.49	17.62	48.33	0.49
Small	15.2	24.1	1.44	21.9	27.6	1.42	30.58	27.24	1.41
Semi-medium	24.2	20.0	2.76	28.5	18.6	2.73	28.20	16.74	2.70
Medium	33.6	12.9	5.94	28.7	8.9	5.76	18.38	7.07	5.67
Large	18.8	2.7	16.08	8.8	1.0	15.77	5.22	0.63	14.83
All	100	100	2.28	100	100	1.78	100	100	1.57

Source Agricultural census

The average monthly income per farm household stood at Rs. 7919 in 2015–16, which is lower than the all—India average of Rs. 8931. But the growth rate of income (3.7%) is the same as that achieved at all—India level (NABARD and NSSO, 2002–03 and 2015–16).

6.2.3 Cropping Pattern in Madhya Pradesh

In Madhya Pradesh, 50% of the reported utilised area was under cultivation. Madhya Pradesh is primarily a food grain-growing state—around 62% of its gross cropped area (GCA) was under food grains and 32% under oilseeds in TE 2014–15. Within food grains, 39% of GCA was under production of cereals while 23% was under pulses. Wheat is the most important cereal grown in the state, accounting for around 24% of the GCA. Among pulses, gram is the main crop grown with around 13% of GCA dedicated to the crop (63% of pulse area), followed by *arhar* (2% of GCA and 10% of area under pulses). Wheat is the major crop grown during the *rabi* season and it is intercropped with gram while in the *kharif* season, MP mostly grows oilseeds, specifically soybean. Around 25.2% of GCA is under soybean cultivation.

Moreover, acreage under the two main crops in MP—wheat and soybean—has increased significantly over the years. Acreage under wheat increased from 4 million ha in TE 1994–95 to 5.6 million ha in TE 2014–15. Similarly, the acreage under soybean increased from 3.2 to 6.0 million ha in the same period. Further, the relative importance of wheat has also increased over the given period. In TE 1994–95, wheat contributed around 16% of GCA; this has increased to 24% in TE 2014–15 (Fig. 6.2). Similarly, the share of area under soybean as a percentage of GCA has increased from 13 to 25%, almost doubled in the past two decades. Acreage under gram, on the other hand, has increased only marginally from 2.4 million ha in TE 1994–95 to 3.0 million ha in TE 2014–15. Consequently, its share in GCA has only increased from 10 to 13% in the same period.

Although MP is one of India's major food grain-producing regions, there has been an increasing trend towards the cultivation of horticultural crops as a cash crop. There has been a significant expansion of area under vegetables in MP after 2010–11. Acreage under vegetables increased from 284,000 ha in 2010–11 to 930,000 ha in 2017–18. This has almost tripled the share of area under vegetables in GCA from 1.3% in 2010–11 to 3.9% in 2017–18. While the expansion of area under vegetables was sudden and took place after 2010–11, in the case of fruits, the expansion began as early as 2008–09. The area under fruit cultivation increased from 47,000 ha in 2007–08 to 92,000 ha in 2008–09 and further to 355,000 ha in 2017–18.

Fig. 6.2 Cropping pattern in Madhya Pradesh. *Source* Directorate of economics and statistics

6.2.4 Determinants of Agriculture Growth

Physical infrastructure such as irrigation, power and roads play an important role in stimulating investment in agriculture and agricultural growth (FAO 1996). Further, several studies (Fan et al. 2007; Fan and Zhang 2004) have shown that investment in rural infrastructure has the potential to increase a farmer's access to input and output markets, stimulate the rural non-farm economy and vitalise rural towns and increase consumer demand in rural areas. In this section, we discuss the development of infrastructure in MP to understand the reasons for the rapid agricultural growth in the state.

6.2.4.1 Irrigation

Irrigation has played a critical role in the growth and development of agriculture in the state. Gross irrigated area has increased from 4.3 million ha in 2000–01 to 10.3 million ha in 2014–15.

Figure 6.3 shows the position of MP as compared to the position at the country level during the period 2000–01 to 2014–15. At the outset (2000–01), the irrigation ratio in MP was 24%, which was around 17.1% points lower than the all—India average. By 2014–15, the ratio had moved up to 43.3%, decreasing the gap with the all—India average to 5.7% points, which is a commendable achievement for the state.

Fig. 6.3 Gross irrigated area as a percentage of gross cropped area. *Source* Directorate of economics and statistics

Fig. 6.4 Region-wise irrigation coverage. *Source* Created by authors

Figure 6.4 shows the region-wise expansion of irrigation coverage. The left-hand graph presents the district-wise irrigation ratio for TE 2002–03 and the right-hand side graph gives the irrigation ratio for TE 2013–14. In TE 2002–03, around 42% of the districts had an irrigation ratio in the range of 15 to 30%, 18% of the districts in the range of 30–45% and 12% of the districts above 60%. By TE 2013–14, the proportion of districts with an irrigation ratio between 15 and 30% decreased to 14%, while the proportion of districts with irrigation ratio in the range of 30–45% increased to 54% and the proportion of districts with irrigation ratio above 60% increased to 26%. The areas that have benefited from irrigation projects have shown an increase in yields leading to higher agricultural growth, changing cropping patterns and an increase in gross cropped area, moving away from a mono-crop regime to double cropping; in some regions, farmers have also been encouraged to take a third crop like *moong* in the summer season (Madhya Pradesh Agriculture Economic Survey 2016).

Fig. 6.5 Source-wise irrigation in Madhya Pradesh. *Source* Directorate of economics and statistics

Source-wise irrigation data reveals that of the various sources of irrigation, dug wells and tube wells occupy the maximum share with 67%, followed by government canals with 17%, followed by other sources with 13% and tanks/ponds with 3%. Figure 6.5 shows that irrigation coverage via all sources expanded between 2000–01 and 2014–15. Specifically, the area under tube well irrigation increased from 0.9 million ha in 2000–01 to 3.3 million ha in 2014–15; dug wells increased from 1.8 to 3.1 million ha. The sharpest increase in irrigation coverage was via tube wells, followed by canals. Private sector investment in the expansion of irrigation through tube wells, wells and ponds and tanks were incentivised through the development of a strong procurement system as well as assured electricity provided by the government. Further, canal irrigation in MP showed robust expansion in all river basins.

Power for Agriculture

As mentioned in the previous section, one of the main reasons for the rapid expansion of tube well irrigation in MP was the government's conscious efforts to ensure assured power for agriculture. The state government started with the unbundling of the power business to bring efficiencies in 2005, and it has made special efforts to ensure separate feeders for power supply to rural areas. The main reason to undertake feeder separation was that rural feeders in MP earlier provided power supply to mixed load for an average of approximately 12 h. There was no supply during the rest of the day due to constraints in generation. Consequently, the agriculture sectors faced several bottlenecks, which are listed below.

- Agricultural pumps during the “pre-feeder separation” period usually received three-phase supply for 6–8 h; for the rest of the period, only one phase supply was available.
- Villages did not get power supply round the clock.
- There was unbalanced loading on distribution transformers (DTR) and power transformers (PTR).
- There were frequent load shedding and high technical losses.

The government made the following interventions to improve the electricity situation for agricultural use in the state:

- Ensured 24 h power supply in the state, out of which 8 h power supply was exclusively for agricultural purposes.
- Provided power to agriculture at a flat rate of Rs. 1200/year, with the facility to pay in two instalments.
- Provided separate rural feeders for agriculture; 43,517 villages have been provided with a separate feeder of 11 KW line comprising 71,688 km and 1516 transformers of 21 KW, which are the country's largest feeders for the agricultural sector.

The *Deen Dayal Upadhaya Gram Jyoti Yojana* (DDUGJY) is a centrally sponsored scheme, which was initiated in 2014 with a feeder separation component. The scheme makes funds available to state governments to take up works to strengthen the distribution system and the separation of feeders for agricultural and non-agricultural consumers. Under DDUGJY, a sum of Rs. 28.7 billion has been sanctioned for MP so far, of which Rs. 15.8 billion is to strengthen the system and Rs. 8.2 billion is for the segregation of feeders.

The objective of the programme is to separate domestic load from irrigation in rural areas and to provide uninterrupted, quality power supply to domestic rural consumers. In other words, feeder separation refers to the supply of electricity to agricultural consumers and to non-agricultural consumers (domestic-non-domestic) separately through dedicated feeders. This arrangement allows the distribution company to regulate power supply to agricultural consumers as and when needed for effective demand-side management (DSM). The separation of feeders helps flatten the load curve by shifting the agricultural load to off-peak hours and thus facilitates peak load supply to agricultural consumers and continuous power supply to non-agricultural consumers in rural areas (DDUGJY 2014).

The efforts of the state government to attract investment for power generation and to expedite feeder separation were long-term policy reforms. In the short-term, the state government strategised to provide temporary power connections for the winter season. Irrigation demand for power during winter was high and farmers were willing to pay a premium of Rs. 2.7–3.0 per unit for assured electricity. The state government contracted advance power purchase for the winter months and began liberally issuing winter season irrigation connections (Shah et al. 2016). Between 2010 and 2013, the state issued 3.12 million winter connections to farmers, increasing the area under wheat cultivation by 1.8–2 million ha/year, leading to increased production.

These efforts have resulted in an increase in the use of electricity for agricultural purposes in MP. It has gradually increased from 4843 MW in 2003 to 10,231 MW in 2013 (GoMP 2016). The share of agriculture in total power consumption in MP is around 33.7%, which is much higher than the national average of 20.8% and higher than in states like Karnataka (33.7%), Punjab (30%), Gujarat (23.6%) and Maharashtra (22.0%).

Although the share of agriculture in total power sales is high (41.4%) (Fig. 6.6), total power sales/gross cropped area (GCA) is low standing at 641 kWh/ha in TE 2015–16 as compared to states such as Tamil Nadu (2019 kWh/ha), Andhra Pradesh

Fig. 6.6 Share of agriculture in total power sales. *Source Report on the performance of state power utilities, various issues*

(1854 kWh/ha), Karnataka (1517 kWh/ha), Punjab (1356 kWh/ha), Haryana (1414 kWh/ha), Maharashtra (1247 kWh/ha) and Gujarat (1087 kWh/ha). Therefore, there is still scope for improvement in power availability.

Agriculture Mechanisation

It is well accepted that the use of mechanised agricultural tools not only reduces the drudgery faced by farmers but also speeds up agricultural processes, saves costs and enhances agricultural productivity. Despite these benefits, farm mechanisation can become economically unviable if farm holdings are fragmented. In order to reap the benefits of mechanisation and, at the same time, address the problems of small farmers, the government of MP used a two-pronged strategy to increase the use of farm machinery in the state. The *yantradoot* village scheme and a scheme to incentivise rural youth to establish custom hiring centres have both contributed significantly to increased mechanisation in agriculture.

The *yantradoot* village scheme was started initially with district level officers of the Department of Agricultural Engineering periodically demonstrating the use of farm implements to farmers in 25 villages spread across 25 districts in the state and making these implements available on hire for the agricultural community at nominal prices. The scheme aims to make each of these villages into models of agriculturally mechanised villages by using modern farm tools for each stage in the production of crops, starting from soil preparation, for cultivation, removing weeds and destroying insect habitats from the field by deep ploughing, improving the fertility of the soil, maintaining the correct distance between rows of crops, promoting seed treatment and proper harvesting and threshing procedures. The 25 villages were selected on the basis of a baseline survey conducted to study farming practices, the potential for introducing small cost-incurring changes in current practices and identifying areas where the new agricultural equipment could be introduced. Once villages were identified, village meetings were organised and a community level plan was formulated to gradually introduce advanced machinery for various stages

Fig. 6.7 Tractor sale in Madhya Pradesh. *Source* Tractor manufacturers association

of farming. Village demonstrations in each of the 25 villages were conducted and appropriate agricultural tools for the particular season were displayed in the village common area. Agricultural officers provide direct information to farmers about the various tools available and the associated benefits. This scheme currently has been scaled up to cover 139 villages as *yantradoot grams* (fully mechanised villages).

Further, to make costly farm equipment available to small farmers, the state government has been helping rural youth under 40 years with an undergraduate degree to set up custom hiring centres (CHC). It takes around Rs. 25 lakh to establish a CHC. The government subsidises 40% of the total cost, i.e. to a maximum amount of 10 lakh. Applicants are required to raise margin money of Rs. 5 lakh and the rest is financed through bank loans. The applicant has to purchase a mandatory set of equipment required for farm activities from ploughing to harvesting. Each centre is designed and developed to cover around 300 farmers within a radius of 10 km. In the first year of the scheme (2012–13), around 286 CHCs were set up; the number increased to 475 in 2015–16. Consequently, the annual sales of tractors in MP increased almost four-fold during 2008–09 to 2014–15—from about 24,306 tractors a year in 2008–09 to more than 87,831 tractors in 2013–14 (Fig. 6.7).

Procurement Policy

Once assured water was made available for wheat cultivation through assured electricity during the 110 days of the wheat season, acreage under the crop as well as wheat production increased significantly. Improved irrigation along with the Madhya Pradesh government's bonus policy on the minimum support prices (MSP) for wheat over and above the centre's MSP between 2007–08 and 2014–15 played a significant role in increasing the production and procurement of wheat (Fig. 6.8). The state bonus on MSP over and above the centre's MSP for wheat between 2007–08 and 2012–13 was Rs. 100 per quintal, while in 2013–14 and 2014–15, it was Rs. 150 per quintal. Consequently, government purchases from the state swelled from around 2% of total wheat procurement in TE 2002–03 to 23% in TE 2016–17, making MP the third-largest contributor to wheat procurement (Fig. 6.9). However, wheat procure-

Fig. 6.8 Production and procurement of wheat in Madhya Pradesh. *Source* Department of food and public distribution and directorate of economics and statistics (DES)

Fig. 6.9 State-wise wheat procurement. *Source* Department of food and public distribution and DES

ment as a percentage of marketed surpluses was around 67% in MP as compared to 81% in Punjab and 74% in Haryana. This shows that despite giving a bonus on MSP, around 33% of marketed surplus was not procured by public agencies, implying that besides public agencies, the private sector too procures wheat. The economic cost of procuring wheat by the Food Corporation of India was around 32 to 43% higher than the MSP during 2008–09 and 2013–14, mainly due to high procurement incidentals (market fees, development cess, *arhatiya* commission, cost of gunny bags, charges to state governments for storage and interest, etc.) and distribution cost. A major contribution to increasing procurement incidentals comes from the high rates of statutory market levies imposed by states. High statutory levies add to the cost of

procurement for FCI, which ultimately adds to the food subsidy bill. States have an incentive to keep these levies high since it contributes to their tax revenues.

On the flip side, high taxes deter private sector procurement and make the state the largest buyer in the wheat market. Interestingly, of the three main contributors to the wheat procurement pool, Punjab and Haryana levies a tax of around 14.5% of MSP and 11.6% of MSP respectively, while MP's rate of taxes was around 7%. The lower taxes in MP may have persuaded private trade to buy wheat from MP rather than Punjab or Haryana. Moreover, in Punjab and Haryana, wheat procurement is mainly through *arhatiyas*, while in MP it is through co-operative societies. MP has been successful in organising its procurement as a decentralised procurement system where wheat is procured by state agencies and only the surplus wheat stocks over and above the state's requirement under the targeted public distribution system/National Food Security Act and other welfare schemes have been taken over by the FCI for dispatch to other consuming regions. In comparison, Punjab and Haryana follow a centralised procurement system, wherein state agencies procure wheat and then preserve the stocks under their custody for which carry overcharges are paid to them. Later, FCI takes over the stocks for dispatch to consuming states as per requirement/movement plan (Fig. 6.8).

While there was an increase in the production of wheat in the upstream segment of the value chain, markets in MP had poor market infrastructure to make correct forecasts of the production level and expected procurement. Consequently, once procurement started, markets were crowded with long queues of farmers wanting to sell their produce, leading to overcrowding and the choking of roads leading to the markets and creating chaos. Moreover, manual payments to farmers through cheques led to delay, losses and corruption. In order to deal with these problems, the MP government re-modelled procurement through digitisation. The "e-Uparajan" initiative was conceptualised to regulate the number of farmers bringing their produce by maintaining records of farmers willing to sell at the MSP and allocating a date to each farmer through SMS. This programme's primary objective was to enable a smooth, regulated and efficient procurement process.

Further, to facilitate the procurement of foodgrains, the Madhya Pradesh State Civil Supplies Corporation Ltd (MPSCSC) and MP State Co-operative and Marketing Federation in consultation with the state government made necessary procurement arrangements in the allotted procurement areas. Each district collector appoints societies to open their centres for procurement operations. The numbers of centres and their locations are decided by the district collector. For example, for wheat procurement, 2967 procurement centres were in operation in *rabi* 2015–16 while there were 884 procurement centres for paddy procurement in the same year.

The other related aspect of procurement is storage. In MP, there has been a steady increase in the average capacity and utilisation of warehousing services. In 1999–2000, the average owned capacity of the Madhya Pradesh Warehousing and Logistics Corporation (MPWLC) was 1245.3 thousand MT; this had increased to 1496.6 thousand MT in 2013–14. Despite this, in 2013–14, the total average hired capacity of MPWLC remained at 4361.5 thousand MT and around 81% of the total capacity was occupied. Thus, even though the storage needs of the state were partially met,

MPWLC must establish enough storage capacity to reduce dependence on hired capacity. The latest figures reveal that MP has created in total 181.3 lakh MT of storage capacity. The state government has introduced the “Warehousing and Logistics Policy 2012” to promote the establishment of silos. Under this policy, the following incentives were provided.

- The state government will provide land on a licence basis for 30 years (extendable by mutual consent for another five years at a time subject to a maximum period of 10 years).
- The state government will also provide viability gap funding (VGF) up to a maximum of 20%, if required, in addition to the 20% VGF by the Government of India under the VGF Policy. However, projects availing of the benefit will not be eligible for capital investment and interest subsidy. Moreover, the projects are mandated to be awarded through a transparent bidding process and are eligible for a business guarantee for 10 years.

Besides, to increase storage capacity, the state has started building steel silos for food grain storage in nine districts. Currently, steel silos account for 4.5 lakh MT of storage capacity in the state. MPWLC has also undertaken the building of steel silos through public-private partnerships on a design, build, finance, operate and transfer (the “DBFOT”) basis. For this purpose, global engineering, development and management consultants, Mott MacDonald, have been appointed by the MPWLC to prepare the feasibility report for setting up steel silos in the state.

The Madhya Pradesh government has also started using silo bags to provide temporary buffer capacity for the state’s crops during years of bumper harvest. This was in the wake of the unanticipated shortage of jute bags, despite a meticulously prepared plan for their purchase, to buy and store wheat during the wheat procurement period in 2012. Mechanised equipment is currently being used to fill grain into large bags, which are then sealed shut on both ends to create dry and near-airless storage that acts as a barrier to pests and insects. Such sealed bags can be left on flat and open land for around 18–24 months. Currently, there are two companies in India that offer silo bags—Panama Agritech and Silobag India—both currently operating in Madhya Pradesh. Silo bags in MP are offered as an on-demand, pay per use service. Unlike warehouses or conventional silos where storage capacity needs to be bought and paid for in the long term, regardless of actual usage, silo bags are rented on a per tonne, per month basis. Other benefits of silo bags that have been documented are the following:

- (1) Silo bags allow farmers to deposit their loose grain directly for storage, eliminating the need to transport and weigh the grain several times, and reduce losses due to pilferage and wastage. In Madhya Pradesh, silo bag sites are temporarily declared as “*mandis*” by the state government so that farmers can directly bring their grain to the sites from farms.
- (2) Customers whether government or private can buy storage capacity in 2–4 weeks compared to the months and years that it takes to plan and erect warehouses or conventional silos.

In MP, there is a pressing need to increase storage capacity due to the increasing procurement of food grains. Moreover, with the growing importance of horticulture in the state, there is also an urgent need to build storage infrastructure for fruits and vegetables because they are highly perishable. Before launching the National Horticulture Mission, the total capacity of multi-purpose cold storage facilities was over 7 lakh tonnes, of which over 50% were used for potatoes. Currently, the state has around 144 cold storages with a storage capacity of 8.05 lakh MT.

Price Deficiency Payments Scheme

The Government of Madhya Pradesh introduced the *Bhavantar Bhugtan Yojana* in September 2017 covering eight *kharif* crops. Under this scheme, farmers selling crops in the notified APMC yard will obtain the difference between the MSP and average sale price (ASP) where ASP is the average of the prevailing modal *mandi* prices in MP and two other states. The crops covered under the scheme are maize, *moong*, *urad*, *tur*, soybean, groundnut, sesame and *ramtil*. The scheme also provides warehouse storage incentives (WSI) for registered farmers. A study by Gulati et al. (2018) reviewed the scheme. The analysis shows that MP could benefit only 23% of production, which poses the question whether the scheme benefits the majority of farmers. It also estimates that extending this scheme to other crops will escalate the costs from Rs. 56,518 crore to Rs. 1.13 lakh crore, given that the market price is 10% lower than the MSP.

Development of Roadways

Roads play a very important role in the development of rural areas as it reduces transportation cost, increases competition, reduces marketing margins, connects input and output markets and improves farm incomes. Figure 6.10 shows that road density in MP has increased from 526.8 per thousand sq. km in 2000–01 to around 941 per thousand sq. km in 2015–16. Further, surfaced roads as a percentage of total roads have increased from 49 to 83% in the same period. In the case of rural roads, the *Mukhya Mantri Gramin Sadak Karyakrama* (popularly known as the CMGSY) was launched to supplement the Prime Minister's Rural Roads Programme (PMGSY) in order to improve the connectivity of villages with urban areas. The CMGSY originated to provide road connectivity to each MP village with a population in the range of 250 and 500 that had not been covered by the PMGSY until the year 2013. The Mahatma Gandhi National Rural Employment Scheme (MGNREGA-MP), the Backward Regional Grant Fund and the state plan head are the three functional components for running the CMGSY scheme. The scheme aims to provide employment under MNREGA and create durable assets in rural areas. This initiative by the state will result in an additional 19,386 km length of gravel roads in the state.

Despite making progress in rural road development, the state's road density is still lower than the national average of 1430 per thousand sq. km (2015–16). Moreover, surfaced roads as a percentage of total roads is much higher (above 89%) in states like Haryana, Punjab and Gujarat among others; therefore, MP has potential to improve its road network further. Towards this end, the state has initiated a master plan for rural road construction, up-gradation and maintenance. Under this master plan, the

Fig. 6.10 Road development in Madhya Pradesh. *Source* Ministry of roads, transports and highway, several issues of basic road statistics of India

state has undertaken a 'District Rural Road Plan (DRRP)', which is a collection of the existing and proposed road network system in a district. Through the DRRP, the state government has been able to clearly identify proposed networks to connect unconnected habitations to already connected habitations.

6.3 Composition of the Agricultural Sector and Sources of Agricultural Growth

To analyse the composition of agriculture in MP, we have computed the share of the value of output from different segments as a percentage of the gross value of output from agriculture and allied activities (at current prices), and to determine the sources of growth, we have deflated the current series of each segment by the WPI at 2011–12 prices and then decomposed the year-on-year growth in GVO from agriculture and allied activities by taking the absolute year-on-year difference in GVO from each segment as a proportion of the previous year's GVO from agriculture and allied activities.

Figure 6.11 shows that in MP, food grains (cereals and pulses) is the largest segment constituting around 29% of GVOA followed by livestock (19%), fruits and vegetables (18.3%) and oilseeds (12.8%). The share of food grains in the total value of output from agriculture and allied activities fell from 30.9% in TE 2002–03 to 29% in TE 2015–16, while that of livestock fell from 25.4% to 18.9% and oilseeds marginally declined from 15% to 13% in the same period. In comparison, there was a significant expansion in the share of the fruits and vegetables segment from 9.5% in TE 2002–03 to 18.3% in TE 2015–16. This shows that although food grains continue to be a dominant segment, MP is also diversifying towards high-value crops such

Fig. 6.11 Sector-wise share in total value of output from agriculture and allied activities (at current prices). *Source* State-wise estimates of value of output from agriculture and allied activities, CSO, MOSPI

as fruits and vegetables. In the following section, we look in greater detail at the disaggregated changes within each segment.

The primary source of agricultural growth in MP for the period 2000–01 to 2015–16 was fruits and vegetables, followed by livestock, cereals and oilseeds. Of the 8% average growth in GVOA for the period 2000–01 to 2015–16, 27% was contributed by food grains, 21.2% by fruits and vegetables, 12.5% by oilseeds and 17.6% by livestock (Fig. 6.12).

Foodgrains Sector

In MP, the largest segment in terms of acreage and value is food grains. Within cereals, wheat and rice are the major crops produced in MP; gram and *arhar* are important pulses. The decline in the share of food grains has been because of a decline in the share of *jowar*, barley, maize and small millets within the cereals segment. Wheat, the main cereal grown in MP, has shown a gradual increase in importance in the production basket.

In line with the expansion of acreage under wheat cultivation, the production of wheat also increased significantly in MP from 6.4 million metric tonnes in TE 1994–95 to 17.6 million metric tonnes in TE 2016–17. Between 2010–11 and 2011–12, wheat production jumped by 51% from 7.6 million metric tonnes to 11.5 million metric tonnes and thereafter, kept a high growth trajectory. Currently, MP is the

Fig. 6.12 Sources of growth 2000–01 to 2015–16 (Share in growth contributed by each segment). *Source* CSO, Government of India, state-wise estimates of value of output from agriculture and allied activities

Fig. 6.13 Production of major cereals in Madhya Pradesh. *Source* Directorate of economics and statistics

second-largest wheat producer, after Uttar Pradesh, contributing around 16% of total production. However, this was not the case in the early 2000s. In TE 2002–03, MP contributed only 8% to total production of wheat and it was the fourth-largest producer after Uttar Pradesh (36%), Punjab (22%) and Haryana (14%). Productivity of wheat cultivation in the state also increased from 1.5 MT/ha in TE 2002–03 to 2.9 MT/ha in TE 2016–17. However, MP has much to achieve in terms of productivity as

its productivity is still lower than that of Punjab (4.7 MT/ha), Haryana (4.4 MT/ha) and Rajasthan (3.0 MT/ha).

In comparison, the share of the pulses segment in GVOA declined in both the major pulse crops—gram and *arhar*. However, in terms of production, gram production increased from 2.1 million metric tonnes in TE 1994–95 to 3.3 million metric tonnes in TE 2016–17 while *arhar* production increased from 0.4 million metric tonnes to 0.6 million metric tonnes in the same period (Fig. 6.13). Currently, MP is the largest producer of gram (39% of the total production) and third-largest producer of *arhar* (13% of total production) in India.

Horticulture

The largest increase in production has been in the fruits and vegetable segment. Figure 6.14 shows the increase took place after 2010–11, with the value of output from fruits and vegetables as a percentage of GVOA increasing from 8.5% in 2010–11 to 19.5% in 2013–14. Private sector investment in irrigation augmented productive capacity and the involvement of public investment in roads connected the hinterland to markets, bolstering the production of perishables like fruits and vegetables.

Production of vegetables increased from 3.7 million metric tonnes in 2010–11 to 18.2 million metric tonnes in 2017–18. This remarkable increase has improved MP's position in vegetable production from 8th in 2010–11 among other states to become the third-largest vegetable producer in the country in 2017–18, only after Uttar Pradesh and West Bengal; this helped increase MP's contribution to total production from 2.8 to 10% in the same period. The productivity of vegetables stood at 19.6 MT/ha, which was higher than the national average of 17.8 MT/ha. In terms of acreage, the top three vegetables cultivated in MP are potatoes, onions and tomatoes. Potatoes and onions account for round 18% of the area under vegetable cultivation

Fig. 6.14 Value of output from F&V as a percentage of gross value of output from agriculture and allied activities. *Source* CSO, Government of India, state-wise estimates of value of output from agriculture and allied activities

Fig. 6.15 Production of vegetables and fruits in Madhya Pradesh, 2005–06 to 2017–18. *Source* National horticulture database

in the state while tomatoes account for 11%. Currently, MP is the second-largest producer of onions (after Maharashtra with 14% of total production); fourth-largest producer of potatoes (with 5% of total production) and third-largest producer of tomatoes (after Maharashtra and Andhra Pradesh with 15% of total production).

In MP, 1.5% of gross cropped area is devoted to the production of fruits in the state. The production of fruits has been increasing steadily since 2007–08. Around 35% of the area under fruits is under citrus fruit cultivation, 26% under orange cultivation and 14% under banana; the production of all these fruits has increased since 2007–08 (Fig. 6.15).

The horticulture segment has become the sunrise sector for MP. Given the huge potential in the state for horticulture, the Government of Madhya Pradesh announced the “Horticulture Hub (H2) Establishment Policy, 2012”. The purpose of this policy was to establish protected cultivation of horticultural crops in a commercial and organised manner. One or more centralised facilities will be made available for the production of high-quality plantation material, grading, sorting, packaging, etc., for products to be grown in horticultural clusters. It is expected that generally more than one cluster (village groups) will be linked with a hub. In 2012–13, Rs. 250 million was made available to establish horticultural hubs in the state. Under this policy, facilities are expected to be established by engaging private investors through the MP Agro-Industries Development Corporation. As per the policy, land is allotted to information technology companies investing in Madhya Pradesh on a 99-year lease. Prior to the H2, land was allotted to such companies on a 33-year lease under the Information Technology Policy, 2006. Hubs are expected to be established after preparing detailed project reports and getting the reports endorsed by an empowered committee headed by the Chief Secretary. The hub will run under the PPP mode.

Further, to promote agricultural processing, the state initiated the agro and food processing policy in 2012. Under this policy, land allotment to MSMEs is done at a concessional rate of 25% and exemption of stamp duty and registration charges of Rs.

1 per 1000. Moreover, fruits, vegetables, floriculture and other notified agricultural produce purchased in any market area of the state for processing/production are exempted from paying the *mandi* fee. Additionally, power has been subsidised at Rs. 1.5 per unit, subject to a ceiling of 25% of the electric units consumed in cold storage, cold chambers, ripening chambers and individual quick freezing enterprises for five years. In 2009–10, there were 812 agro-based food product industries in MP, accounting for nearly one-fourth of the total industries. This sector contributes an average 30% to the total value of industrial output in Madhya Pradesh. The sector is one of the highest growing sectors in terms of gross capital formation as well as gross value addition with an annual compound growth rate of 37 and 25% respectively (GoMP 2016).

Non-Food Crops

In TE 2015–16, the non-food segment consisting of oilseeds, fibre and sugar comprised around 15% of the total value of output from agriculture and allied activities. In MP, oilseeds alone constitute around 12.8% of GVOA vis-à-vis the national average of 5.3%. At a disaggregated level, soybean accounts for around 78% of the total value of output from oilseeds while rapeseed and mustard account for around 10% and groundnut 5%. The production of soybeans has doubled from 3.3 million tonnes in TE 2002–03 to 6 million tonnes in TE 2016–17. MP was the largest producer of soybeans contributing around 51% of the total production in the country, followed by Maharashtra (35%) in 2016–17.

Livestock

Livestock is the second-largest segment after food grains in MP, contributing around 18.8% of the GVOA. The milk segment contributes around 83% of the total value of output from livestock and the meat segment contributes around 5%. The livestock sector's share in GVOA has declined from 25.4% in TE 2002–03 to 18.8% in TE 2015–16. This is primarily because other segments such as fruits and vegetables have expanded more than livestock.

Milk Segment

In MP, the share of milk in the GVOA has declined from 21% in TE 2002–03 to 16% in TE 2015–16. However, this segment continues to be an important segment for improving farmers' livelihood in MP.

Milk production in MP has grown from 4.8 million metric tonnes in 2000–01 to 13.4 million metric tonnes in 2016–17 (Fig. 6.16), an average annual growth rate of 6.6%. Around 45% of milk production is cow milk and 49% is buffalo milk.

In terms of volume, MP is the sixth largest milk-producing state contributing accounting for around 7% of the total milk production in the country. Although milk production in the state has been increasing, milk productivity in MP is lower than in some other states; for example, while MP's productivity in milk production stood at 0.8 MT per female animal, Punjab's productivity was 2.4 MT per female animal, Gujarat's 1.1 MT per female animal and UP's 1.0 MT per female animal.

Fig. 6.16 Milk production in Madhya Pradesh. *Source* NDDB

One of the factors for low milk productivity could be the lower proportion of genetically superior cattle (crossbred). The exotic/crossbred female cattle population in Punjab is 91.5% of total female cattle population while that in MP is only 6.0% in 2012 (livestock census). Although this proportion is still low, the state has shown a rise in the proportion from 3.2% in the 5 years since 2007. However, the state requires significant scaling up of the population of crossbred/exotic female cattle population in order to improve milk productivity. The yield from crossbred cows is much higher as compared to indigenous breeds. On average, a crossbred cow yields 7.2 kg/day nationally while an indigenous cow yields 2.5 kg/day. In MP, the average yield of exotic/crossbred cow is around 6.5 kg/day while indigenous cows yield around 2.1 kg/day.

Milk in MP is mainly marketed by dairy co-operatives. The Madhya Pradesh State Co-operative Federation is the apex body and it has five regional milk unions located in Bhopal, Gwalior, Indore, Jabalpur and Ujjain for procurement. On average, these unions procure around 9.3 lakh kg of milk per day from 2.4 lakh members. These members are associated with 6219 dairy co-operatives (2015–16). Only about 15% of MP's total milk production is processed by the organised sector compared to 49% in Gujarat.

Meat and Eggs Segment

Meat accounts for only 5% of the total value of output from the livestock segment. Its share in GVOA has marginally increased from 0.6% in TE 2002–03 to 1% in TE 2015–16. Between 2006–07 and 2014–15, meat production increased from 20,000 to 60,000 tonnes (Fig. 6.17), an increase of 200%. The poultry segment in MP got a stimulus with the establishment of the Madhya Pradesh Women Poultry Producer Company Pvt. Ltd. (MPWPCL). It has ten producer organisations operating under it, each holding a stake in the producer company. Each of these producer organisations is an independent entity involved in providing services such as raw materials, working capital assistance, risk mitigation from input and output price movements and production support, besides marketing broiler poultry for its members and

Fig. 6.17 Production of meat in Madhya Pradesh. *Source* Basic animal husbandry and fisheries statistics

providing training and building capacity among women. The co-operative membership extends to 4214 women poultry producers belonging to poor tribal and Dalit families. Currently, MPWPCL is one of the biggest producers of broiler chicken in the state. This was achieved by first establishing four feed processing units, which supplied feed to the co-operatives, and then taking on the contract for manufacturing medicines. Marketing is done under the brand name “Sukhtawa Chicken”. In 2011, a parent farm and hatchery were commissioned. The end-to-end integration and scale of operations under MPWPCL has given producers the bargaining power to influence market decisions and protect farmers from market volatility and depletion in their profit margin (Garg and Kumar 2011).

Egg production in MP has also increased significantly from 951.8 million in 2006–07 to 1942 million in 2017–18. Such a phenomenal rise in the production of meat and eggs requires enlargement of storage capacity so as to minimise wastage and damage. Although there are at present around 122 cold storages in the state with a total capacity of approximately 712.3 million MT (2012–13), there is a pressing need to develop storage and marketing infrastructure to further bolster the segment.

Fisheries

Since Madhya Pradesh is landlocked, inland fishery is favourable in the state. Although only 0.65% of the GVOA is contributed by fishery, this sector has huge potential. MP has around 4.03 lakh ha of reservoirs and tanks, which can be utilised for fishing.

Fish production has increased from 47.5 thousand tonnes in 2001–02 to 109.1 thousand tonnes in 2014–15, (Fig. 6.18) a CAGR of 5.7%. MP contributes only about 1.6% of the total inland fish production, while major inland fish producing states in India such as Andhra Pradesh and West Bengal contribute around 26% and 23% respectively (GoMP 2016).

Fig. 6.18 Fish production in Madhya Pradesh. Source GoMP 2016

6.4 Drivers of Agriculture Growth: Econometric Analysis

Agricultural growth is influenced by a number of supply-side factors. A priori, we would expect (i) technology (seed replacement rate, irrigation, fertiliser use, farm mechanisation, extension, etc.), (ii) incentives (terms of trade), (iii) infrastructure (electricity, roads) and (iv) weather conditions to drive agricultural growth. However, it is difficult to analyse the effect of all variables in a single framework, both because of paucity of data and because many of these variables can be correlated. The correlation matrix of these variables is presented in annexure Table 6.3. Therefore, we use a parsimonious model to analyse the potential drivers of growth.

Estimating Equation

In our model, log GDPA is the dependent variable and the variables mentioned above are independent variables. The equation has been estimated using data from 2000–01 to 2015–16. The variables that had a positive and significant correlation with GSDPA that have been used in our regression model are: (i) irrigation ratio (IRR), (ii) surfaced road density (Road) and (iii) terms of trade between agriculture and industry (ToTAI).

$$\ln \text{GSDPA} = \beta_0 + \beta_1 \ln \text{IRR} + \beta_1 \ln \text{Road} + u_t \quad (6.1)$$

$$\ln \text{GSDPA} = \beta_0 + \beta_1 \ln \text{IRR} + \beta_1 \ln \text{ToTAI} + u_t \quad (6.2)$$

The results from these regression models have been presented in Table 6.2.

In Model 1, it can be seen that irrigation and roads have a significant and positive effect on agricultural GDP. The two independent variables together explain around 96% of the variation in agricultural GDP for the studied period. Since we have estimated a double log model, the results can be interpreted as follows: *ceteris paribus*, a

Table 6.2 Regression results

	Model 1	Model 2
Irrigation ratio (lnIRR)	1.25***	1.43***
Surfaced road density (lnRoad)	0.20**	
Terms of trade between agriculture and industry (lnToTAI)		0.26*
Constant	10.3***	10.9***
No of observations	16	16
Adj R-square	0.96	0.96

*** significant at 1% ** significant at 5% * significant at 1%

1% growth in irrigation ratio increases agriculture growth by 1.25%. Similarly, a 1% growth in surfaced road density increases agriculture growth by 0.20%. In Model 2, it is observed that irrigation and terms of trade in favour of agriculture have a significant and positive effect on agricultural GDP. The two independent variables together explain around 96% of the variation in agricultural GDP. As in the case of Model 1, the second model can be interpreted as follows: *ceteris paribus*, a 1% growth in the irrigation ratio increased agriculture growth by 1.43 and a 1% change in terms of trade in favour of agriculture increased agriculture growth by 0.26%.

6.5 Conclusion and Policy Implications

As discussed before, the five main factors that have contributed to agricultural growth in Madhya Pradesh are (i) expanded irrigation through tube wells and canals, (ii) increased power supplies to agriculture, (iii) assured and remunerative price for wheat (including bonus over MSP) by strengthening the wheat procurement system, (iv) expansion of all-weather roads and (v) suitable incentives and signals for the private sector to increase the level of investments to reap the benefits of trunk infrastructure and improved services. Public investment in the development of infrastructure in the state (especially roads, power supplies and canal irrigation) has also played a vital role in transforming agriculture in MP. These findings have important policy implications for many other states like Bihar, Odisha, Uttar Pradesh, etc., which have ample scope to accelerate growth in their agriculture sector. While initiatives in each state will have to be designed to cater to local needs and priorities, the major takeaways from the experience Madhya Pradesh in agricultural development for moderate performing states can be summed up as follows.

- (i) Expand ground-water and surface water irrigation through assured power supplies to rural areas through power feeder separation.
- (ii) Establish a strong procurement system so that farmers can reap the benefit of the government minimum support price scheme.

- (iii) Invest in all-weather surfaced roads for efficient movement of products and inputs to and from rural areas and link farmers to processing units and consumers.
- (iv) Public investments in key infrastructure such as improved power supply and better road connectivity to incentivise and attract private investment at the farm level in the form of increased investment in tube wells, expansion of area under horticulture, especially the adoption of high-value crops such as seasonal vegetables, and setting up of dairy units.

To sustain agricultural growth in Madhya Pradesh, the following points are worth considering:

1. Up to the Eleventh Plan, irrigation potential created (IPC) as a percentage of ultimate irrigation potential (UIP) was 22.3% for micro-irrigation projects; it was 51.5% for major and medium projects. There is still scope for investment in order to bridge the gap between IPC and UIP.
2. It is also noteworthy that MP has significant under-utilised sub-soil water resources in almost all regions, especially in the eastern part. There is a case for addressing power infrastructure and supply gaps in the eastern part on a priority basis to attract farm level investment in private tube wells to exploit available water resources. This is likely to result in an expansion in assured irrigation and promote both productivity growth in existing crops and diversification into horticulture.
3. Although road density in MP has increased over the years from 526.8 per thousand sq. km in 2000–01 to around 941 per thousand sq. km in 2015–16, it remains lower than the national average of 1431 per thousand sq. km. Besides, surfaced road as a percentage of total roads in MP at 83% is much lower than in states like Punjab and Gujarat where the percentage of surfaced roads is over 89%. Therefore, MP has the potential to improve its road network further.
4. The share of agriculture in total power sales is high (33.7%) but total power sales/GCA is low, standing at 518 kWh/ha in TE 2012–13 as compared to states such as Tamil Nadu, Andhra Pradesh, Karnataka, Punjab, Haryana, Gujarat and Maharashtra that use over 1000 kWh/ha for agriculture. Therefore, there is still scope for improvement in power availability, which will increase uptake of private irrigation.
5. With the increasing importance of the horticultural sector, there is a need to expand and strengthen infrastructure such as cold storage, warehouses, processing units and organised retail for value chain development. In particular, MP has emerged as the second-largest producer of onions after Maharashtra in recent years but has been unable to fully leverage its proximity to the major consuming markets of northern India due to inadequate storage capacity. Addressing this gap through incentives to create storage facilities both at the farm level as well as organised cold storages based on solar power will significantly enhance the capacity of the state's farmers to benefit from price differentials during lean supply months.

6. MP was among the first of the major states to remove horticultural produce from the monopoly of the Agriculture Produce Marketing Committee (APMC) controlled *mandis* in 2012. It needs to follow up this decision with policy incentives to attract private market yards offering electronic and sample-based trading. This will bring bulk buyers, processors, exporters, etc., to the state to source fresh produce and provide greater marketing choice to farmers. At present, MP is a net exporting state for fruits and vegetables, given its low urban population. Its favourable location, enabling quick access to both major northern and western urban markets, could be leveraged successfully with appropriate policy incentives.
7. A related issue in the agricultural marketing policy is the roll-out of the Government of India's e-NAM electronic marketing portal, where MP has been a relatively low key participant so far. Given the wide range of crops offered by the state and its location in the centre of the country, accelerated expansion of the e-NAM platform could benefit farmers in due course in terms of increased selling choices. MP pioneered the *e-chaupal* initiative over a decade and a half ago with a private sector partner (ITC) and saw improved price realisation for soybean farmers. e-NAM is a public initiative and could bring benefits to a much larger number of farmers across a larger area, if patronised by the state and implemented after due assaying, grading of produce and setting up of an effective dispute settle mechanism between buyers and sellers.
8. We have already commended the role played by public procurement of wheat in incentivising area expansion, higher returns to farmers and other spin-off benefits. MP is well placed to replicate the model in the case of pulses, which is of critical importance to the rain-fed regions of the state, especially the Bundelkhand and Baghelkhand regions, and is the mainstay of smallholder agriculture in these regions. With the Government of India announcing a policy decision to create a buffer stock of 2 million MTs of pulses, MP can deploy its tested *e-Uparajan* initiative for the benefit of pulse farmers. Even if no bonus is paid over and above the MSP, it will result in large gains for the average cultivator of pulses by reducing their market risk. Public procurement of pulses is likely to see a repetition of some of the favourable outcomes witnessed in the case of wheat and is a low hanging fruit ready to be plucked.
9. Although milk production has increased from 4.8 million tonnes in 2000–01 to 10.8 million tonnes in 2014–15, milk productivity in the state is lower than in some of the other states. For example, while MP's productivity in milk production stood at 0.8 MT per female animal per year, productivity in Punjab was 2.4 MT per female animal per year, Gujarat 1.1 MT and UP 1.0 MT per female animal per annum. One of the factors for this low milk productivity could be the lower proportion of genetically superior cattle (crossbred). In Punjab, the exotic/crossbred female cattle population as a proportion of the total female cattle population was around 91.5%, while in MP, it was only 6.0% in 2012. The state needs to significantly scale up the population of crossbred/exotic female cattle population to improve milk productivity.

10. MP recently passed legislation to legalise agricultural tenancies, based on the model draft circulated by the Government of India. This is a major reform measure in a state that hitherto did not permit legal leasing of land. Implementation guidelines to follow up on the law have still to be issued. These should be released expeditiously to enable registration of tenancy under the new legal provisions. The new law should be publicised widely and a transparent dispute resolution mechanism put in place to build public confidence in this measure. Implemented fairly, the land leasing law could help increase investments in better technology and irrigation, as stable tenures and fair rents will encourage tenants to invest in productivity-enhancing measures.
11. A large number of farmer producer organisations (FPOs) have emerged in the state in the past decade, thanks to progressive policies to encourage their growth. Some of these FPOs are now doing impressive work in agricultural production, marketing and value addition. The state has put in place a set of incentives to strengthen these farmer-owned organisations through financial support, infrastructure building and relaxation of the provisions of the APMC Act. However, ready access to affordable working capital remains a challenge for many FPOs, given their weak equity base. Given that equity concerns are well addressed by such bodies, there is a justifiable case to enhance the level of public support to registered FPOs. Among the most effective measures would be a state-level credit guarantee fund, which would provide comfort to all institutional lenders licensed by the RBI for loans advanced to FPOs up to a limit (say Rs. 200 lakh).

Annexure

See Table 6.3.

Table 6.3 Correlation matrix

	GSDPA	Irrigation ratio	Fertiliser consumption	Total	
GSDPA	1				
Irrigation ratio	0.93***	1			
Fertiliser consumption	0.80***	0.92***	1		
Road	0.94***	0.83***	0.72***	1	
ToT	0.93***	0.85***	0.81***	0.97***	1

*** Significant at 1% **Significant at 5% * Significant at 10% ## Variables are in log form all variables in log form

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