

# Chapter 9

## Drivers of Agricultural Growth in Odisha



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### 9.1 Introduction

Odisha is the ninth largest state in India with a share of 4.7% of India's total landmass. In terms of population, it is the eleventh largest comprising 3.47% of India's total population, of which more than 83% is rural (Census 2011). Odisha is a mainly agrarian economy with a GSDP value of Rs. 3.74 trillion at current prices. Over the years, the share of agriculture in the gross state domestic product has declined from around 37% in TE1992–93 to 21% in TE2017–18 and that of industry and services increased correspondingly (CSO 2019). Even though the share of agriculture in GSDP is declining, the number of persons engaged in agriculture remains high. According to NSS reports, more than 55.7% of Odisha's population is engaged in agriculture and related sectors (NSS 68th round 2014) (45% according to the Labour Bureau, 2015–16). Agricultural policy can have a direct impact on a large proportion of the population.

Odisha is one of the poorest states in India, with a large section of its rural population living below the poverty line, lagging behind other states in terms of agricultural growth during the last couple of decades. Its agricultural GDP grew at an average three per cent between 1991–92 and 2017–18. Political stability in the state in the last decade contributed to progress in agriculture, arising from enhanced budgetary allocations towards agriculture, infrastructural development and new beneficial government policies and initiatives. The KALIA scheme of income support for farmers and agricultural labour in Odisha was much talked about and led other state governments,

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central governments and even opposition parties to announce similar schemes in the run-up to the general elections in early 2019.

Predominantly with red soil, Odisha produces a wide variety of commodities, the most notable being paddy, mangoes, tomatoes, brinjal, sugarcane, jute and poultry. Even though paddy is the most cultivated crop with a share of almost 48% in gross cropped area, farming in the state has diversified towards high-value agriculture including fruits and vegetables and livestock. However, the frequent occurrence of extreme natural calamities like floods, cyclones and droughts is a major constraint that agriculture in the state faces. In 2019, a devastating cyclonic storm, “FANI”, caused large-scale destruction in the state. Dealing with natural calamities has necessitated the allocation of a sizeable portion of government’s funds, which could have been used for agricultural and other developmental activities, towards reconstruction and rehabilitation. These events have impeded agriculture growth, lowered farmers’ income and hampered the overall development of the state.

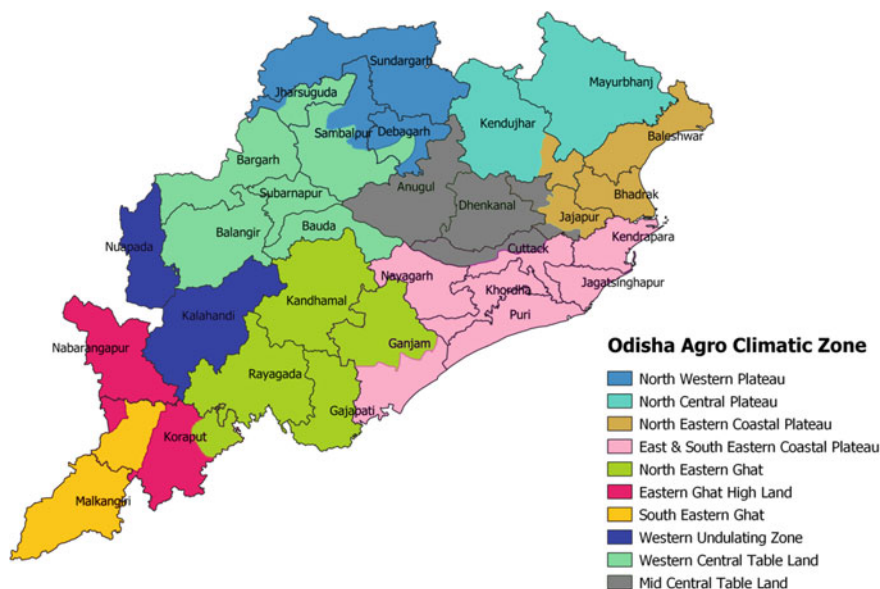
This chapter will examine the sources and drivers of agricultural growth in the coastal state. The chapter is organised into six sections as follows. The introduction is followed by a detailed overview of agriculture in the state in Sect. 9.2. Section 9.3 analyses the composition and sources of agricultural growth in Odisha. Section 9.4 gives the econometric analysis used to derive the drivers of agriculture growth in the state. In Sect. 9.5, Odisha’s agricultural budget has been discussed. Section 9.6 concludes, providing policy prescriptions to achieve and sustain high agricultural growth in Odisha.

## 9.2 Overview of Odisha’s Agriculture

Based on climate, soil, rainfall and cropping pattern, Odisha is divided into ten agro-climatic zones: north-western plateau, north-central plateau, north-eastern coastal plain, east and south-eastern coastal plain, north-eastern *ghat*, eastern *ghat* high land, south-eastern *ghat*, western undulating zone, western central table land and mid-central table land (Fig. 9.1). Located on the eastern side of peninsular India, Odisha is prone to natural calamities such as cyclones, floods and even droughts. Between 2000 and 2019, Odisha has been affected by floods in 15 out of the 19 years and by droughts in 8 (GoO 2017; PIB 2018).

### 9.2.1 Agricultural Growth

During the last two decades, Odisha has not achieved the growth in agriculture that other states have. Gross state domestic product in agriculture (gross value added at



**Fig. 9.1** Agro climatic zones—Odisha. *Source* Created using QGIS from Government of Odisha's data

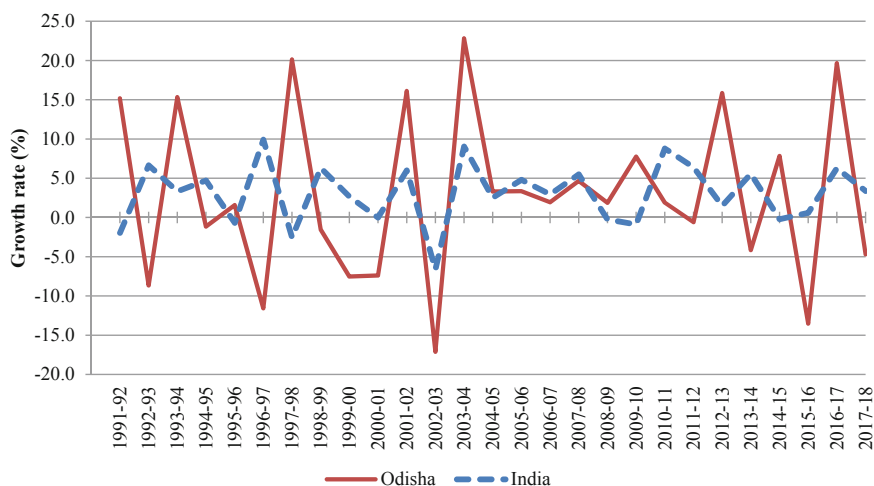
basic prices<sup>1</sup> after 2011–12) grew at an average rate of 3.9% since 2001–02 and 3% since 1991–92. Even though Odisha's agriculture GDP grew at the same average rate as the all-India growth rate, the state's growth rate has been more volatile, with a coefficient of variation (CV) at 355% compared to India's CV of 84% (Fig. 9.2). Agricultural growth declined five times during the 1990s due to natural calamities.

During the 2000s, Odisha recorded positive growth rates. However, the present decade (2011–12 to 2017–18) has already seen negative growth rates in four of seven years, making Odisha one of the poorest performing states in terms of agricultural growth.

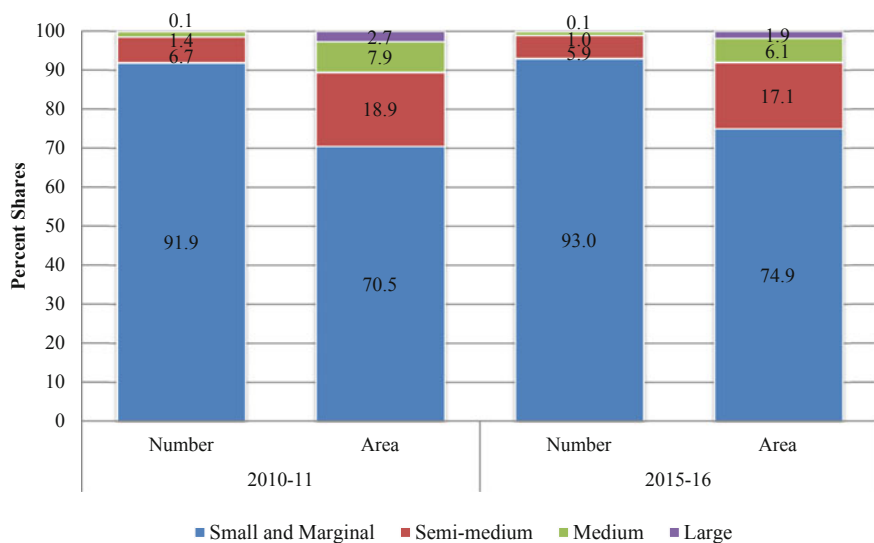
## 9.2.2 Agricultural Livelihood in Odisha

Like other states in India, Odisha too is dominated by small and marginal farm holdings. Of the total 48.7 lakh farm holdings in Odisha, 93% are in the small and marginal category with less than 2 ha of land accounting for around 75% of the total land. The number of small and marginal farmers has increased by 5.6% between 2010–11 and 2015–16 (Fig. 9.3). Large farmers (landholding size >4 ha), on the

<sup>1</sup>Gross value added at basic prices is defined as output valued at basic prices less intermediate consumption valued at purchasers' prices.



**Fig. 9.2** Growth rate in agriculture and allied sectors in India and Odisha. *Source* (CSO, Various Issues)



**Fig. 9.3** Share of operational holding (%). *Source* (Agriculture Census 2015–16)

other hand, are a mere 0.1%, with around 2% of the total land (Agriculture Census, 2015–16).

Odisha has 32.6% of the population below the poverty line (Tendulkar Committee 2011). The state's per capita income in 2017–18 was Rs. 80,991 compared to the national average of Rs 126,043. However, Odisha has achieved the fastest reduction

in poverty rates from 61% in 2004–05 to 36% in 2011–12. The important contributory factor for this has been rising incomes from the livestock sector (Hoda et al. 2017).

In 2015–16, the average monthly income per agriculture household was Rs. 7731 compared to Rs. 8931 at the all-India level according to NABARD's Financial Inclusion Survey for 2015–16, which is among the lowest in India, but is better than the average monthly income in Andhra Pradesh (Rs. 6920), UP (Rs. 6668) and Bihar (Rs. 7175) (NABARD 2018).

### 9.2.3 Land Utilisation and Cropping Pattern

Land utilisation pattern<sup>2</sup> in Odisha has undergone considerable change over the last two decades. While land available for agriculture has declined, there is a substantial increase in fallow lands. Gross cropped area (GCA) decreased from 9.6 m ha during TE1992–93 to 8.5 m ha during TE2016–17 and the net sown area (NSA) fell from 41 to 36% of the total geographical area of 15.6 m ha during the same period. This decline in cultivable land can be attributed to increased salinity in soil due to frequent flooding, soil erosion and inadequate irrigation during the *rabi* season.

Fallow land other than current fallows and current fallows together accounted for 5.3% of the total geographical area during TE2016–17 against 2.3% during TE1992–93. During TE2012–13, fallow land had touched 1.1 million hectares, about 7% of the total geographical area, due to irregular rainfall, frequent natural calamities, lack of irrigation facilities and poor soil quality in the state. There have also been large conversions of agricultural land to non-agricultural land for use in industrial and domestic constructions.

Odisha is predominantly a rice-producing state but the cropping pattern has been evolving as can be seen in Fig. 9.4. The most notable change since TE 2001–03 has been that the share of rice in the GCA has fallen while that of pulses has increased.

### 9.2.4 Determinants of Agriculture Growth

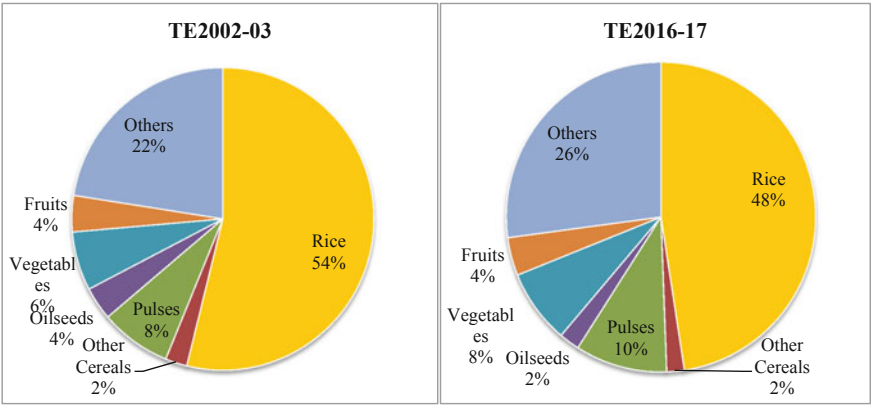
We analyse below the status of physical infrastructure such as irrigation, power and road and other factors like diversification that have played a critical role in the growth of the agriculture sector.

#### Irrigation

Irrigation is by far the most important driver of agricultural growth in Odisha. Odisha is heavily dependent on rainfall and receives annual precipitation of 230.76 bcm. The normal annual rainfall in Odisha is 115 cm of which the South-West monsoon

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<sup>2</sup>There is discrepancy in LUS data of DES, GoI; hence, data from Odisha Agriculture Statistics have been used

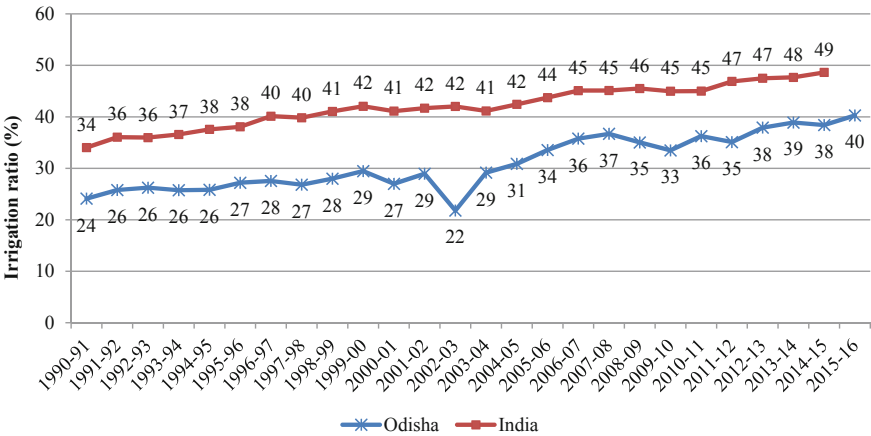


**Fig. 9.4** Area under crops as % of gross cropped area (GCA). *Source* DES

months contribute 79% in the months of June to September (IMD 2016). There is also spatial variation and the northern plateau gets higher rainfall than the southern coastal plains. Because of temporal and spatial variations in rainfall, exacerbated by the frequent occurrences of floods and drought, the development of irrigation infrastructure assumes importance for agriculture.

The irrigation ratio (gross irrigated area as a proportion of gross cropped area) in Odisha has consistently remained below the all-India level. While the irrigation ratio in 2014–15 was 38.4 in Odisha, it was 48.6 at the all-India level (Fig. 9.5).

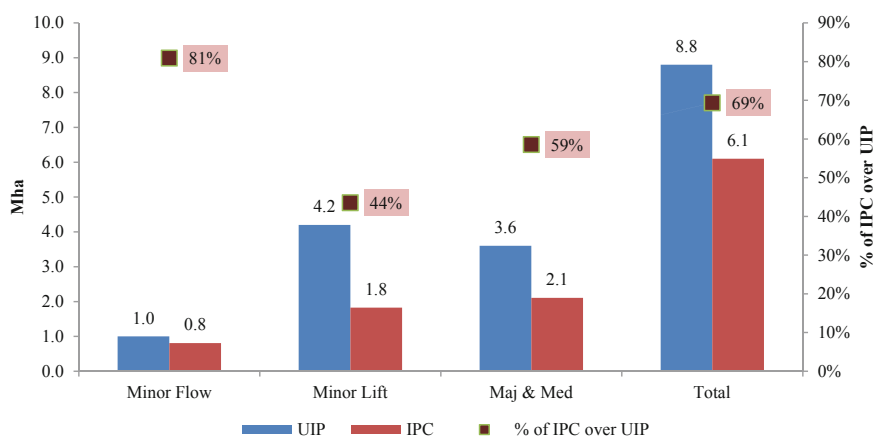
Against the ultimate irrigation potential (UIP) of 8.8 m ha in Odisha, 3.6 million hectares can be created using major and medium projects, 1 million hectares using



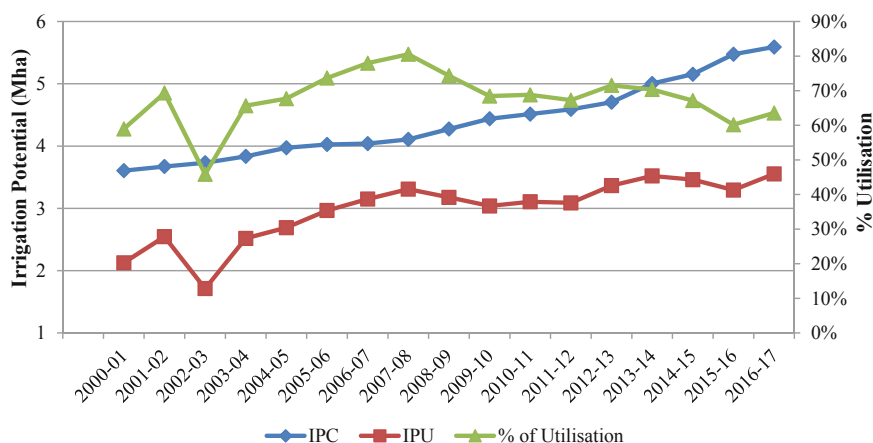
**Fig. 9.5** Irrigation Ratio (Odisha and India). *Source* (Odisha DES, Various Issues) and (Land Use Statistics, DES 2018)

minor flow and 4.2 million hectares using minor lift irrigation projects. As of 2018–19, 81% of minor flow had been exploited as against 44% in minor lift and 59% in major and medium projects (Fig. 9.6).

Until 2016–17, the potential of 5.6 m ha or 64% had been created out of the UIP of 8.8 million hectares. However, only 3.6 m ha or 64% of irrigation potential created (IPC) has been utilised so far. In fact, the share of utilisation in IPC (share of irrigation potential utilised over irrigation potential created) has been declining since 2007–08 after it peaked at 81% (Fig. 9.7). In major and medium irrigation projects, the main reason for the shortfall in utilisation is the lack of field channels



**Fig. 9.6** Ultimate Irrigation Potential (UIP) and Irrigation Potential Created (IPC) in Odisha (2018–19). Source DoWR, Odisha



**Fig. 9.7** Gap between irrigation potential created and irrigation potential utilised in Odisha. Source (DoWR, Odisha)

in the command area, and poor maintenance of distribution infrastructure. In minor irrigation schemes, it is the siltation of channels and tanks.

Odisha has abundant groundwater resources—about 16.69 lakh bcm. However, the state lags behind in the development of these resources as only 5.02 lakh bcm or 30% of the total potential has been used so far for different purposes, especially for irrigation (DoWR Annual Report 2016–17). Deficiencies in the transmission and distribution infrastructure of power are the main reasons for the low level of utilisation of groundwater.

Due to frequent droughts, there is a decline in the groundwater level, particularly in the southern plains. To tackle this problem, the Odisha government has signed an agreement with NABARD to develop infrastructure for groundwater recharge and solar micro-irrigation to ensure food security and enhance resilience in 15 districts with financial assistance from the South Korea-based Green Climate Fund (NABARD 2018). The project is expected not only to improve the water table in the state but also to enhance the water quality for the health and well-being of about 52 lakh vulnerable communities in these districts who are prone to food and water insecurity.

Out of the ninety-nine (99) ongoing major/medium irrigation projects under the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY)—Accelerated Irrigation Benefits Programme (AIBP)—due to be completed by December 2019, eight are in Odisha with a targeted potential of 371,500 ha to be created. According to the AIBP dashboard, three of these had already been completed by September 2019 (PMKSY-AIBP 2019).

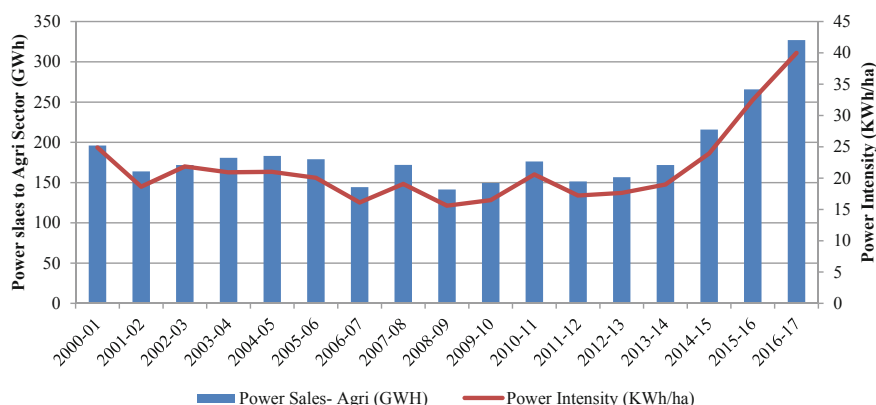
## Power

Electricity is an important input for agriculture for use in irrigation and operating agricultural machinery and equipment and is considered as an indicator of an economy's development. However, Odisha's situation in power sales/consumption is poor, especially when it comes to the agricultural sector, resulting in under-utilisation of groundwater resources in Odisha.

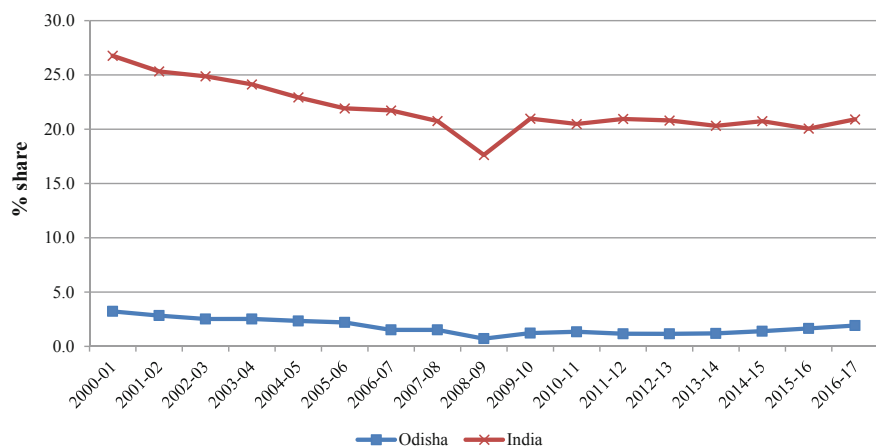
The per hectare power consumption in agriculture or power intensity in Odisha is among the lowest in the country. While Odisha recorded a power intensity of 24 KWh/ha during 2014–15, states like Tamil Nadu with 2070 KWh/ha, Haryana with 1477 KWh/ha and Karnataka with 1469 KWh/ha were the highest-ranked states in terms of power intensity. Punjab and Gujarat had higher power intensities whereas Madhya Pradesh (633 KWh/ha) and Uttar Pradesh (450 KWh/ha) had lower power intensities than at the all-India level. Apart from Odisha, only Bihar had a low power intensity at 41 KWh/ha. In recent years, however, there has been a substantial increase in power intensity, which reached 41 KWh/ha in 2016–17. This is the result of increasing power sales to the agriculture sector in recent years (2014–15 to 2016–17) (Fig. 9.8).

However, Odisha has the lowest agricultural power sales to total power sales ratio in the country. As shown in Fig. 9.9, the share of the agricultural sector in total power sales declined from 3.2% during 2000–01 to 1.9% during 2016–17 as compared to all-India's share from 26.8% that declined to 20.9% during the same period. In states like





**Fig. 9.8** Power sales and power intensity in Odisha (agricultural sector). *Source* Authors own calculation using data from Central Electricity Authority (CEA), Various Issues and (Odisha DES, Various Issues)



**Fig. 9.9** Share of agriculture in total power sales. *Source* (CEA, Various Issues)

Uttar Pradesh (19.3%), Gujarat (19.6%), Punjab (27.7%), Madhya Pradesh (37.9%) and Rajasthan (41.9%), power sales to agriculture shares were way higher than in Odisha during 2016–17. While power sector reforms took place in Odisha during the 1990s when generation, transmission and distribution activities of the Orissa State Electricity Board (OSEB) were unbundled and an independent and transparent regulatory regime was established, the consumption of power in the agricultural sector remained low. In 1999, power distribution was privatised to bring efficiency. This resulted in decrease in the aggregate technical and commercial (AT&C) losses in the state from 57% in 1999–00 to 38% during 2014–15. However, it is still way higher than the national average of 21.4%.

Although Odisha has surplus power, the state faces extreme deficit in supply during peak demand, apart from high voltage fluctuations and frequent load shedding especially in rural areas. This poor quality of power situation in Odisha explains the reasons for lack of a supply chain infrastructure including cold storages and milk processing in the state. The Government of India's scheme of *Deen Dayal Upadhya Gram Jyoti Yojana* (DDUGJY) for rural areas was launched to resolve issues related to the quality and quantity of power to agriculture. The major aim of the scheme was to separate agriculture and non-agriculture feeders, facilitating judicious supply to agricultural and non-agricultural consumers, to strength transmission and distribution infrastructure and for rural electrification. However, Odisha does not seem to be taking full advantage of the funds available under the *Gram Jyoti Yojana*. About four years ago, 31 projects were sanctioned for a sum of Rs. 1654 crore, but as on August 31, 2019, only Rs. 670.51 crore had been drawn by the state (DDUGJY Portal 2019).

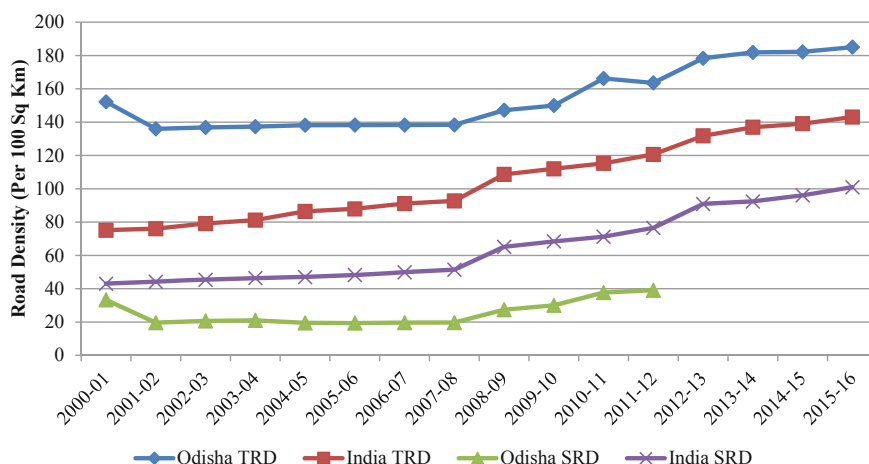
According to the Government of India, complete rural electrification has been achieved in Odisha with 100% of its villages electrified under the *Saubhagya Yojana*. As of 31 April 2019, all 47,677 villages in Odisha stand electrified. However, inadequate and unreliable power supply remains one of the pressing problems in rural Odisha. In a joint initiative with all state governments, the Government of India launched “ $24 \times 7$  Power for All ( $24 \times 7$  PFA)” to provide reliable power to consumers apart from adequate power supply to the agriculture sector (MoP 2016). While the *Saubhagya* scheme provided access to all,  $24 \times 7$  PFA will provide sustainable and  $24 \times 7$  power to all.

To boost solar energy power generation, the Odisha government plans a total of 2378 MW of solar energy to be established by the Green Energy Development Corporation Limited (GEDCOL) in co-ordination with the Odisha Renewable Energy Development Agency (OREDA) by 2022. The state government is also promoting the use of 0.5 hp solar photo voltaic pump sets in areas with no or inadequate electricity supply. The government provided 90% subsidy for solar power pumps to around 5000 farmers during 2017–18 and 2018–19 to increase irrigation potential and cropping intensity in the state (GoO 2019).

## Roads

Odisha has a road network of 2.9 lakh km with 77% being rural roads. Odisha's total road density in 2015–16 stands at 185 km per 100 km<sup>2</sup>, much higher than the all-India average of 143 km per 100 km<sup>2</sup>. Odisha's total road density was constant between 2001–02 and 2007–08 when the average road density in India was rising. Since 2008–09, Odisha's total road density has increased at the same pace as India's (Fig. 9.10). However, in terms of surfaced road density, Odisha is behind the average for the country as a whole, and in fact, the gap has been widening since 2001–02, as can be observed in the figure. In 2011–12, only 23.9% of the total roads in Odisha were surfaced as compared to 89% in Gujarat and Punjab, 77% in Uttar Pradesh, 61.5% in Madhya Pradesh and 47.2% in Bihar.

Due to inconsistent data for surfaced roads in Odisha after 2011–12 in Basic Road Statistics, we have limited our analysis from 2000–01 to 2011–12.



**Fig. 9.10** Total road density and surfaced road density for Odisha and India. *Source* (Basic Road Statistics of India (Various Issues))

### Diversification

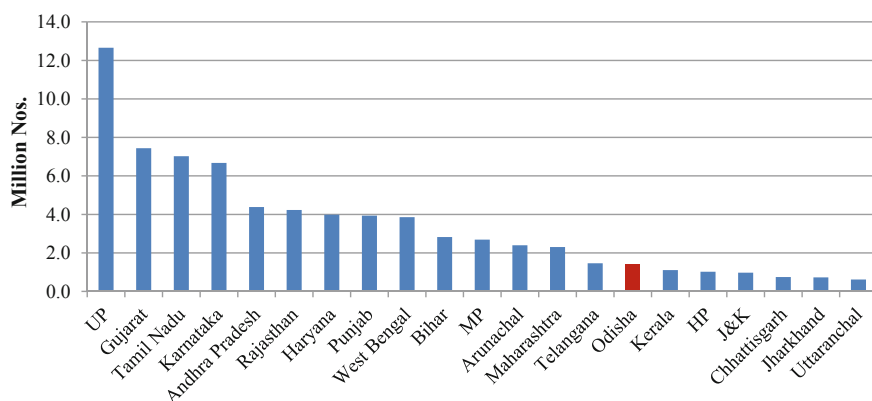
With increasing demand for high-value agricultural commodities like milk, meat, fruits and vegetables, there is pressure for change in the cereal centric policies of the government. The increasing value of livestock and horticultural output as compared to food grains testifies to the process of diversification in Odisha's agriculture and highlights the need for government to take supportive action to foster the development of value chains.

### Horticulture

Horticulture in Odisha suffers not only from the lack of organised marketing but also from a shortage of cold storage facilities for perishable fruits and vegetables. As of 2017, Odisha had 171 cold storages, which represented a mere 2.2% of the total cold storage capacity in India. Most of these cold storages are used for keeping potatoes. More cold storages are needed for potatoes as well as other fruits and vegetables. Solar-powered cold storages are another option, which also has lower operational costs compared to traditional cold storages. Processing facilities for fruits and vegetables, which the state lacks, is another area of concern.

### Dairy

The dairy sector faces a different set of issues. Odisha's dairy sector suffers from low animal productivity, poor marketing and low levels of milk processing. Odisha had 1.4 million artificial inseminations (AIs) performed in 2017–18, which was just 2% of total AI performed in India. As shown in Fig. 9.11, UP (12.7 m) had the highest number of AIs performed followed by Gujarat (7.4 m), Tamil Nadu (7 m) and Karnataka (6.7 m). To strengthen the dairy industry in Odisha, there is a need to set up more dairy co-operative societies, collection centres and processing facilities.



**Fig. 9.11** State-wise artificial inseminations performed (2017–18). *Source* Basic Animal Husbandry Statistics

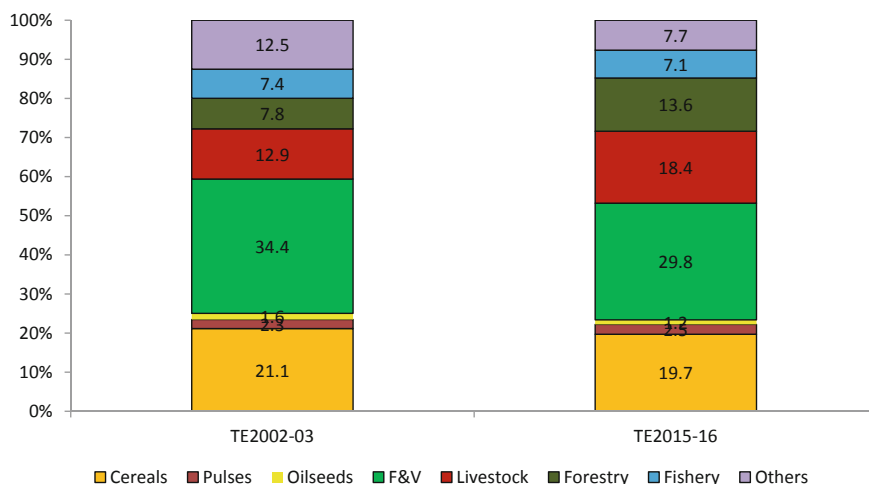
Linking farmers with the organised milk processing sector through producer-owned dairy co-operatives will make dairy farming more sustainable for Odisha farmers.

The low productivity of milch animals in the state is despite the fact that the best germplasm is being used in the state for artificial insemination and cross-breeding. The low productivity is ascribed by state officials to the diet of milch animals. Farmers do not have the incentive to improve their diet to increase production because market expansion has been too slow to enable the off-take of increased output. In this situation, in order to increase productivity, farmers need to reduce the herd size, so that milch animals constitute a higher proportion. To achieve this, the state needs to adopt cutting edge reproduction management technologies, such as semen-sexing (Hoda et al. 2017).

### 9.3 Composition and Sources of Agricultural Growth

Even as the cropping pattern of Odisha is dominated by foodgrains especially rice, it is fruits and vegetables that have a higher share in gross value of output from agriculture and allied activities. Cereals had a 20% share in gross value of output during TE2015–16, down from 21% in TE2002–03 (Fig. 9.12). Rice contributed 98% of the total value of cereal output. While fruits and vegetables still dominate GVO, its share declined from 34% in TE2002–03 to 30% during TE2015–16. Livestock is an emerging sector in Odisha, with the value of output increasing from 12.9 to 18.4% during the same period. The livestock sector is dominated by meat (49%) and milk (39%).

Let us now decompose the sources of agricultural growth in Odisha. In order to do this, we will use gross value of output (GVO) at current prices for different segments and total gross value of output from agricultural and allied activities. To analyse the

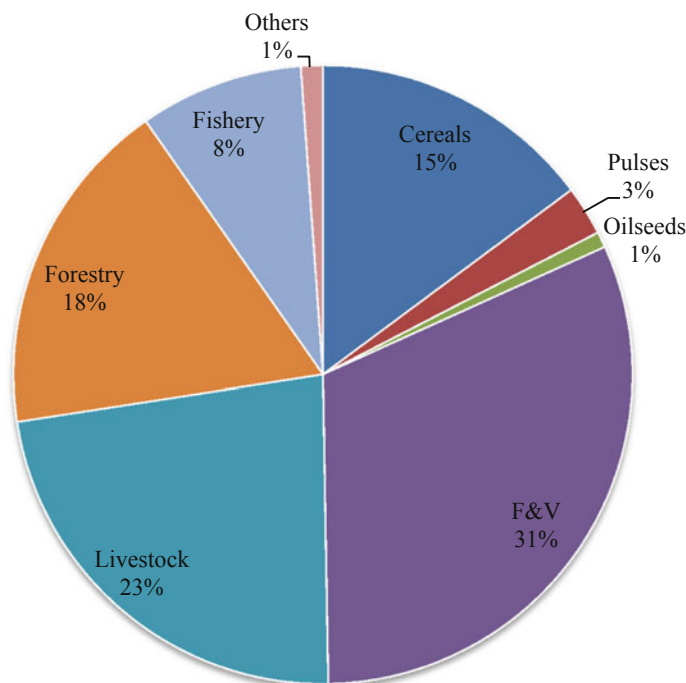


**Fig. 9.12** Sector-wise shares in gross value of output from agriculture and allied activities. *Source* (MoSPI, State wise estimates of Value of Output from Agriculture and Allied Activities, Various Issues)

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

Using the above methodology, the average growth of GVO for the agricultural and allied sector in Odisha was computed to be 6.54% annually between 2000–01 and 2015–16. Decomposing this growth into various sectors shows that high-value agriculture commodities like fruits and vegetables, and livestock had the maximum shares. While fruits and vegetables contributed 31.5% share to this growth, livestock accounted for 23%. Coming in third position, cereals had a 15% share in the growth. Pulses contributed a mere 3%, while oilseeds had a 0.8% share in the growth. Forestry and fisheries contributed 17.8 and 8.6% shares, respectively (Fig. 9.13).

Let us now discuss each of these segments briefly in terms of production and productivity growth, government policies and the overall success and failure of the sector.



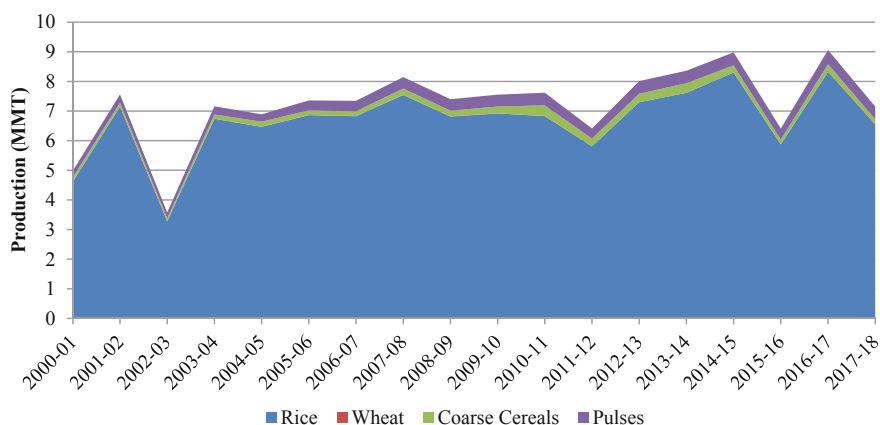
**Fig. 9.13** Sources of growth in GVOA of Odisha. *Source* Authors own calculation using data from MoSPI

### 9.3.1 Foodgrains

#### Cereals

Rice is the dominant crop within cereals, accounting for 48% of the gross cropped area in Odisha (and accounting for 96% of the area under cereals) and 19.3% of GVOA (98% of the total value of output of cereals). The state ranks third for rice acreage and sixth for rice production among all Indian states. Rice production increased from 5.8 MMT during TE1992–93 to 6.9 MMT during TE2017–18. However, there was a substantial decline in rice production from 8.3 MMT in 2016–17 to 6.6 MMT in the following year, affecting overall foodgrains production in the state (Fig. 9.14). This decline lowered Odisha's rank from fourth to sixth in rice production. The steep fall in production was due to drought conditions in 2017, compounded by a pest attack and unseasonal rainfall (Odisha Eco Survey 2018–19).

Even though Odisha has a share of 6.3% in India's total rice production (TE2017–18), its rice productivity is among the lowest in the country. There was an improvement in its rice productivity from 1.1 mt/ha during TE2002–03 to 1.8 mt/ha to TE2017–18, but it still lags behind the national average of 2.5 mt/ha. All major rice-producing states have higher productivity than Odisha including West Bengal (2.9 mt/ha) and Uttar Pradesh (2.2 mt/ha). Punjab had the highest productivity of



**Fig. 9.14** Foodgrains Production in Odisha. *Source* DES, Government of India

4.1 mt/ha. States like Andhra, Haryana, Tamil Nadu and Telangana recorded productivity levels of more than 3 mt/ha. Maize is another cereal produced in Odisha; however, it stands nowhere compared to rice, with just a 2% share in the total value of cereal output.

### Pulses

Pulses contribute just 2% to the gross value of output from agriculture and allied activities. The share has been almost constant over the last two decades. There was a steep decline in pulses production from 1.5 MMT during TE1992–93 to 0.23 MMT during TE 2002–2003, since when it has recovered to 0.43 MMT during TE2017–18. *Tur* and *moong* are the two important pulse crops cultivated in Odisha. Not among the major producers of pulses in India, the state's productivity in pulses lags behind the national average productivity levels.

### 9.3.2 Oilseeds

Odisha is not among the major players in the oilseeds economy of India as it contributes less than 0.5% to the national production of oilseeds. The share of oilseeds in GCA stands at 2%, while its share in GVOA is just 1%. Like pulses, oilseeds production too saw a substantial fall since the 1990s, declining from 0.68 MMT during TE1992–93 to 0.13 MMT during TE2016–17. Even though, the national production of oilseeds has increased in the last two decades, making India its largest producer, rice-centric Odisha has long neglected this sector.

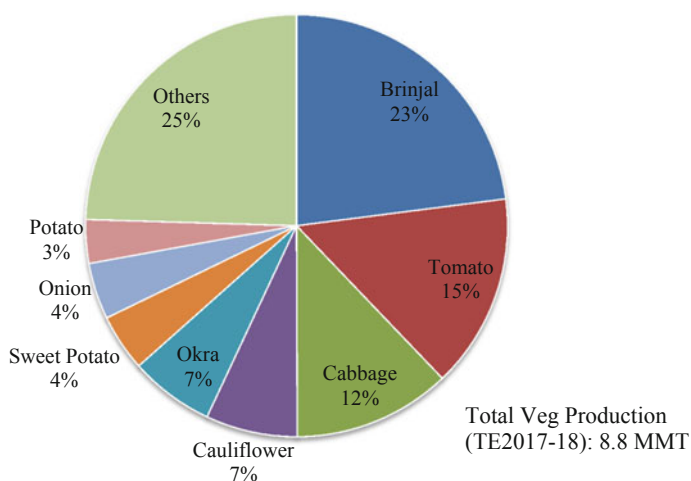
### 9.3.3 Fruits and Vegetables

With just a 12% share in gross cropped area, fruits and vegetables have a 30% share in gross value of output from agriculture and allied activities (GVOA). While its contribution to GVOA has declined from 34% during TE2002–03 to 30% during TE2015–16, fruits and vegetables contribute the largest share to GVOA among all segments of agriculture and allied activities.

#### Vegetables

Odisha is the seventh-largest producer of vegetables contributing 4.9% to total vegetable production in India. Accounting for 8% of GCA, Odisha produced around 8.8 MMT of vegetables during TE2017–18 (DoAC&FW 2019). Not among the major producers of potato, which is by far the largest cultivated and produced vegetable in India, Odisha is among the largest producers of other important vegetables. Major vegetables grown in Odisha in descending order of their contribution to the value of output include brinjal (18.1%), tomatoes (11.2%), cabbage (5.9%), okra (5.6%), cauliflower (4.3%), onion (3.3%) and sweet potato (2.5%), constituting 50.8% of the total value of output of fruits and vegetables (TE2016–17). These vegetables, along with potato, represent three-fourths of the total vegetable production in the state (Fig. 9.15). In comparison to other states, Odisha is the largest producer of sweet potato and pumpkin (*sitaphal*), the second-largest producer of brinjal and cabbage, fourth-largest producer of okra, bitter gourd and cauliflower and the fifth largest producer of tomatoes in India.

We have compared the productivity of important vegetables grown in Odisha with the average productivity in the country (Table 9.1). While during the last 10 years, the productivity of vegetables has generally improved in the state, it remains below



**Fig. 9.15** Share of Major Vegetables Produced in Odisha (TE 2017–18). *Source* (DoAC&FW 2018)



**Table 9.1** Productivity comparison of Odisha's major vegetables

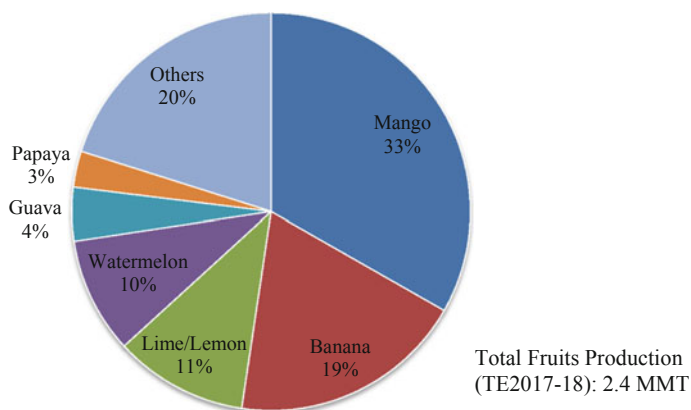
Vegetables	Productivity (t/ha)			
	Odisha		India	
	TE2007–08	TE2017–18	TE2007–08	TE2017–18
Brinjal	14.8	17.1	16.8	17.9
Tomato	13.3	14.3	17.7	25.1
Cabbage	27.6	28.1	22.3	22.4
Okra	8.7	8.8	10.2	11.8
Cauliflower	14.2	15.1	18.4	19.0
Sweet Potato	8.5	9.4	8.8	11.5
Others	11.9	11.5	13.6	14.0
Total	12.4	13.6	15.7	17.4

*Source* National Horticultural Database 2008, 2009 and Horticulture Statistics at a Glance 2018

the all- India average, except in the case of cabbage. Like many other states in India, Odisha is also affected by the boom and bust cycles of vegetable prices. With bumper crops of tomatoes, farmers here often resort to distress sales and even dump their produce on roads in the absence of proper marketing, storage and processing facilities. On the other hand, potato consumers in Odisha face another type of crisis in the form of price rise leading to heavy dependence on other states like West Bengal and Uttar Pradesh to meet its needs. Odisha produces 3 lakh mt of potatoes, which is less than 1% of national production. The state government implemented “Potato Mission” in 2015–16 to increase potato production and achieve self-sufficiency. However, with heavy crop losses due to late sowing, Odisha could not achieve the target and the mission failed. The recently announced “Operation Green” scheme of the Government of India under the Ministry of Food Processing includes Odisha’s two districts-Mayurbhanj and Keonjhar which have been selected for tomato clusters. This scheme aims to stabilise the prices of three of the most important vegetables: tomatoes, onions and potatoes (TOP) by ensuring availability of the product throughout the country round the year without price volatility. However, even though the guidelines have been issued, the scheme has not taken off as yet.

## Fruits

Fruits are cultivated on 4% of Odisha’s gross cropped area, making the state the twelfth largest fruit producer, ranking sixth in acreage (DoAC&FW 2019). Odisha produced 2.4 MMT of fruit crops during TE2017–18, which was 2.6% of the country’s total fruit production. With poor productivity recorded for most fruits, Odisha’s fruit productivity (7.1 mt/ha) is only 50% of the national average (14.6 mt/ha). Mango is the most important fruit crop produced in Odisha, contributing the largest share to production at 33%, in terms of both the value of output and acreage under fruits. Other important fruits produced in the state are banana, lime/lemon, watermelon, guava and papaya (Fig. 9.16). The area under mango has increased significantly from 53,000 ha during TE1992–93 to 19.9 lakh hectares



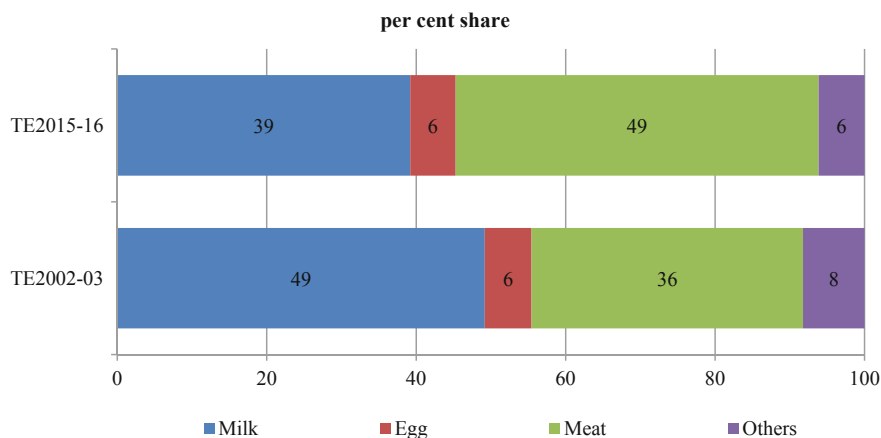
**Fig. 9.16** Share of Major Fruits Produced in Odisha (TE 2017–18). *Source* (DoAC&FW 2018)

during TE2017–18. Odisha is the eighth largest mango producing state in India with a total production of 8 lakh mt during TE2017–18, contributing 4% of the country's total mango production. However, productivity is among the lowest in the country with only 4 MT per hectare during TE2017–18 compared to India's average of 9 MT per hectare. Even though the state has 10% of the total acreage under mango in the country, it contributes just 2.6% to total mango production. APEDA data for exports suggest that Odisha is the second-largest exporter of mangoes after Maharashtra, and even its low-quality mangoes get exported to neighbouring countries, Nepal and Bangladesh. Odisha has the potential to increase mango yields if it adopts ultra-high-density mango planting and micro-irrigation technologies for mango orchards. Maharashtra has already adopted these and now the state is the country's largest mango exporter to the world.

### 9.3.4 Livestock

The growth of the livestock sector in Odisha has been phenomenal in the last one and half decades. Its share in the gross value of output from agriculture and allied activities (GVOA) has increased from 12.9% during TE2002–03 to 18.4% during TE2015–16. Milk contributed 39% of the GVO from livestock during TE2015–16, meat 49% and eggs 6%. The dominance of meat is a recent phenomenon as milk had a 49% share in livestock GVO during TE2002–03 compared to the share of meat at 36% (Fig. 9.17).

Odisha has 4.1% of the bovine population and 2.7% of the poultry population of India (Livestock Census 2012). Cattle form the majority of the bovine population with a 95% share while buffaloes constitute a mere 5%. A comparison of different livestock censuses reveals that Odisha's livestock population declined from 24 million in 2003 to 23.1 million in 2007 and further to 20.7 million in 2012. The poultry population

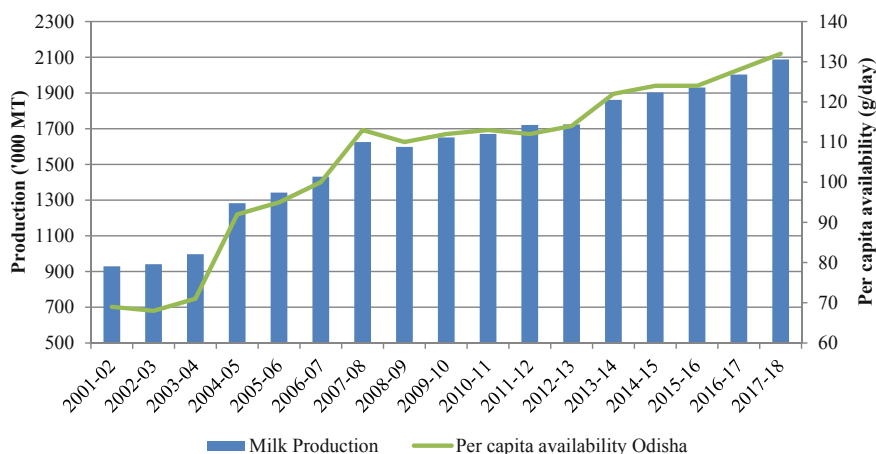


**Fig. 9.17** Composition of Value of Output from Livestock. *Source* Authors own calculation using data from MoSPI

increased from 17.6 million in 2003 to 20.6 million in 2007, declining slightly to 19.9 million in 2012.

### Milk

Milk production in Odisha increased from 0.92 MMT in TE2002–03 to 2 MMT in TE2017–18 (Fig. 9.18). Odisha ranks sixteenth in milk production in India with a share of 1.2%. Odisha's per capita availability of milk at 128 g/day is among the lowest in India. Out of the total milk production in Odisha during TE2017–18, 87% was cow milk, 12.8% was buffalo milk and 0.2% was goat milk. The average yield



**Fig. 9.18** Milk production and per capita availability in Odisha. *Source* (Basic Animal Husbandry and Fisheries Statistics, Various Issues)

for crossbred cows in Odisha was 6.2 kg/day, for indigenous cows 1.4 kg/day and for buffaloes 3.9 kg/day during TE2017–18, which are all lower than the national average.

The low productivity of milch animals in Odisha can be attributed to poor feed quality and high breeding overheads. An FAO report (Gerber et al. 2013) notes that “about 57 of the dairy herd in South Asia is composed of non-milk producing animals compared with a global average of 41% in dairy cattle mixed systems”. As recommended in the report, the relative share of productive animals in the herd can be increased by improving animal health and adopting advanced reproduction management technology such as semen-sexing in artificial insemination. The report adds: “The adoption of semen-sexing technology for 25% of the dairy cows in India was estimated to reduce male calf numbers by 9%”.

The Odisha State Co-operative Milk Producers’ Federation Limited (OMFED) was established under Operation Flood of NDDDB. It had 5852 dairy co-operative societies registered with 2.76 lakh members in 2017–18. Average procurement by OMFED was 9.3% of total milk production in the state in TE2017–18, compared to GCMF’s procurement of 53.7% of production in Gujarat. Private players operating in the milk business in Odisha include Pragati Milk Products Private Limited with a plant capacity 250 KLPD milk, and Milk Mantra, which is India’s first venture capital-funded start-up in the food sector.

## **Meat**

Meat production in Odisha has more than quadrupled from 42,000 MT during TE2002–03 to 175,000 MT during TE2017–18. This explains the increasing share of livestock in the gross value of output from agriculture and allied sectors. However, Odisha’s share in the total meat production in the country has increased only marginally from 2.1 to 2.4% during the period. Even though the increase in meat production was because of both animal meat (goat, sheep, pig) and poultry meat, the composition of meat production has undergone a major shift towards poultry meat. During TE2002–03, 68% of meat production came from goats, 22% from sheep, 9% from pigs and 1% from cattle. However, during TE2017–18, poultry meat contributed to 46% share to total meat production followed by goats (40%), sheep (9%) and pigs (5%).

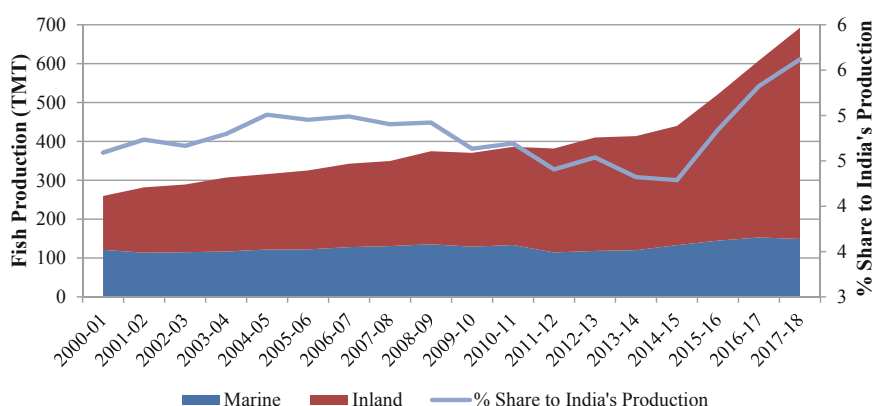
While 70% of total poultry in Odisha consist of backyard breeds, vertical integration of the poultry value chain by several private players is gaining prominence. Earlier dependent on neighbouring states for poultry meat, Odisha now has large broiler integrators like Venky’s, Pasupati and Suguna working with small farmers. These private players have entered into contracts with small farmers and provide them day-old broiler chicks, broiler feed, medicines and vaccines and veterinary services. Once the birds are six weeks old, they are weighed and sold back to the integrator under the respective brand name. Apart from these big private companies, several poultry co-operatives are working for poultry development and providing livelihood to a large number of small farmers.

## Eggs

Eggs are the third largest component of the livestock sector after milk and meat. Egg production in Odisha increased from 843 million during TE2002–03 to 2 billion during TE2017–18, constituting 2.2% of India's total egg production of 88.8 billion. The per capita egg availability in Odisha stands at 46.3 per annum compared to the all-India figure of 70 eggs per annum. Commercial poultry farms contributed 86% of the egg production and backyard poultry only 14% during TE2017–18 compared to 81% and 19%, respectively at the all-India level.

### 9.3.5 Fisheries

Fish has always been an integral part of the Odia diet given Odisha's proximity to a large coastline and lakes. The fisheries sector holds an important place in the state's economy. It not only gives employment opportunities to the large community of fishermen but also contributes significantly to the GDP of the state. The share of the fisheries sector in the gross value of output from the agriculture and allied activities sector, however, declined marginally from 7.4% during TE2002–03 to 7.1% during TE2015–16. Odisha's fish production increased from 277 thousand metric tonnes (TMT) during TE2002–03 to 607 TMT during TE2017–18. The state ranked tenth in fish production with a share of 5.3% during TE2017–18 of which 75% came from inland sources and 25% from marine sources. As shown in Fig. 9.19, there has been a rapid increase in inland fish; marine fish production has remained stable since 2000–01. This increase in inland fish is basically due to an increase in fish production from fresh water sources and brackish water. Freshwater fish from tanks and ponds account for a share of more than 84% of the production. Odisha's share in India's total fish production has hovered between 4 and 6% since 2001–02.



**Fig. 9.19** Odisha's fish production. *Source* (Basic Animal Husbandry and Fisheries Statistics, Various Issues)

The strength of the fisheries sector in Odisha lies in its large unutilised freshwater and brackish water resources. Odisha has not been able to develop its marine fish sector; production has remained stagnant in the last two decades or so. Fish production from fresh water including tanks, ponds, swamps, lakes, reservoirs, rivers and canals can be further developed. There is huge potential for the development of freshwater fisheries in Odisha, which has 32,587 ha of cultivable brackish area, 3 lakh hectares of estuaries, brackish water and backwater areas and 93,000 ha of the Chilika Lake (Perspective Plan 2010–2020 for Fishery Development, Odisha). The government should encourage PPP models for the development of inland, fresh water and brackish water fishery. Apart from the expansion of fishery, the availability of large wet lands in Odisha offers unique opportunities for agricultural development by promoting the cultivation of *makhana*, water chestnut and lotus and the adoption of various combinations of integrated crop-fish-animal farming systems. (Hoda et al. 2017).

## 9.4 Drivers of Agriculture Growth: Econometric Analysis

Growth in the agricultural sector for any state is influenced by a number of supply-side factors. These can be

- inputs (irrigation, fertilisers, agriculture credit)
- technology (quality seeds, farm mechanisation, extension services)
- price incentives (terms of trade)
- infrastructural facilities (roads, electricity)

While all these factors have an impact on agricultural growth, some factors are the key drivers for achieving growth in a particular state. As different states are located in different agro-climatic zones, have varied soil, climate, rainfall and policies, a certain factor may influence agricultural growth to a much larger extent in a particular state than in others. In this section, we use econometric analysis to determine the key drivers of agricultural growth in Odisha.

First, we use representative variables for each of the factors listed above as potential drivers of agricultural growth and run a simple pairwise correlation between gross state domestic product from agriculture and allied activities for Odisha (GSDPA) and a host of other variables. The correlation matrix along with the significance values obtained has been presented in Annexure 1. The GSDPA is shown to have a positive and significant correlation to the following variables: irrigation ratio, total road density, diversification to livestock, terms of trade between agriculture and services, quality seeds and fertilisers.

Under the assumptions of a classical linear regression model, we run a simple ordinary least square regression using the natural log value of GSDPA as the explained variable and natural log values of some of the variables mentioned above (having a positive and significant correlation) as explanatory variables. We run the model with different variables and only those models have been presented here that significantly explain the changes in GSDPA. The variables that had a positive and significant

**Table 9.2** Regression results

Model 1		Model 2		Model 3	
Reg lngsdpa lnir lnroad		Reg lngsdpa lntotas lnlivestock		Reg lngsdpa lnir lnlivestock	
Irrigation ratio	0.7470***	lnTOT(AS)	0.4280**	Irrigation ratio	0.7193***
Road density	0.5585***	lnLivestock	0.4729**	Livestock	0.3718***
Constant	9.6563***	Constant	13.8322***	Constant	11.5490***
R-squared	0.88	R-squared	0.77	R-squared	0.89
Adj R-squared	0.86	Adj R-squared	0.74	Adj R-squared	0.87

\*\*\* and \*\* corresponds to 1 and 5% level of significance respectively

correlation with GSDPA and used in our regression model are (i) irrigation ratio (IR), (ii) total road density (Road), (iii) terms of trade between agriculture and services (ToTAS) and (iv) the share of livestock in the value of output from agriculture and allied activities (Livestock). Data for these variables have been used from 2000–01 to 2015–16. The following models have been estimated:

$$\ln \text{GSDPA} = \beta_0 + \beta_1 \ln \text{IR} + \beta_1 \ln \text{Road} + u_t \quad (9.1)$$

$$\ln \text{GSDPA} = \beta_0 + \beta_1 \ln \text{ToTAS} + \beta_1 \ln \text{Livestock} + u_t \quad (9.2)$$

$$\ln \text{GSDPA} = \beta_0 + \beta_1 \ln \text{IR} + \beta_1 \ln \text{Livestock} + u_t \quad (9.3)$$

The results from the above regression models have been presented in Table 9.2.

The results from the model show that irrigation, road density, terms of trade and diversification in agriculture have a positive and statistically significant impact on GSDPA.

**Model 1** This model shows that keeping other things constant, a one per cent increase in the irrigation ratio increases GSDPA by 0.75%. Similarly, keeping other things constant, an increase of one per cent in total road density increases Odisha's GSDPA by 0.56%. Together, these two variables explain 86% of the variation in GSDPA.

**Model 2** According to this model, keeping other things constant, a one per cent improvement in terms of trade between agriculture and services increases Odisha's GSDPA by 0.43%. Similarly, keeping other things constant, a one per cent increase in the share of livestock to gross value of output from agriculture and allied sectors increases Odisha's GSDPA by 0.47%. Together, these two variables explain 74% of the variation in GSDPA.

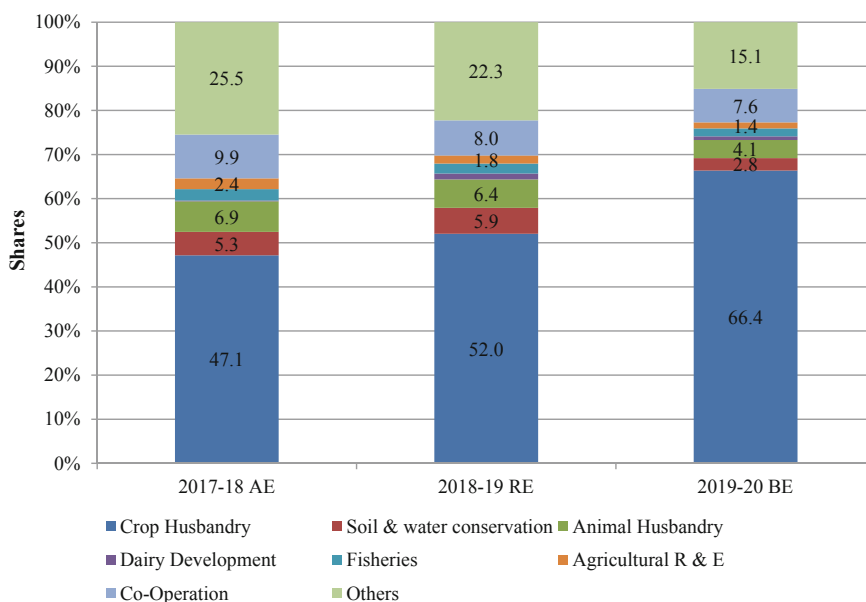
**Model 3** The model shows that, *ceteris paribus*, a one per cent increase in the irrigation ratio increases Odisha GSDPA by 0.72%. Similarly, keeping other things

constant, a one per cent increase in the share of livestock to the gross value of output of agriculture and allied sectors increases Odisha's GSDPA by 0.37%. Together, these two variables explain 87% of the variation in GSDPA.

## 9.5 Agriculture Budget in Odisha

Odisha is among the few states that announce an exclusive budget for agriculture and allied activities. Broad head wise allocations for agriculture and allied activities have been shown in Fig. 9.20. It is clear from the graph that crop husbandry has an almost two-thirds share in the budget estimates (BE) in the 2019–20 budget, up from 52% in the revised estimates for 2018–19. Animal husbandry and dairy development together accounted for a mere 5% in the total budget allocation although in recent years the contribution of livestock in the GVO has been in the range of 18–19%. Compared to 2017–18 and 2018–19, this year's budget had a lesser share for fisheries, with budgetary allocation declining from 2.6 to 1.8%, although the contribution of the segment to GVO in recent years has been more than 7%.

The major highlight of this year's budget was the state government's flagship scheme for direct income support to farmers, "KALIA" (*Krushak Assistance for Livelihood and Income Augmentation*), for which Rs. 5611 crores was allocated.

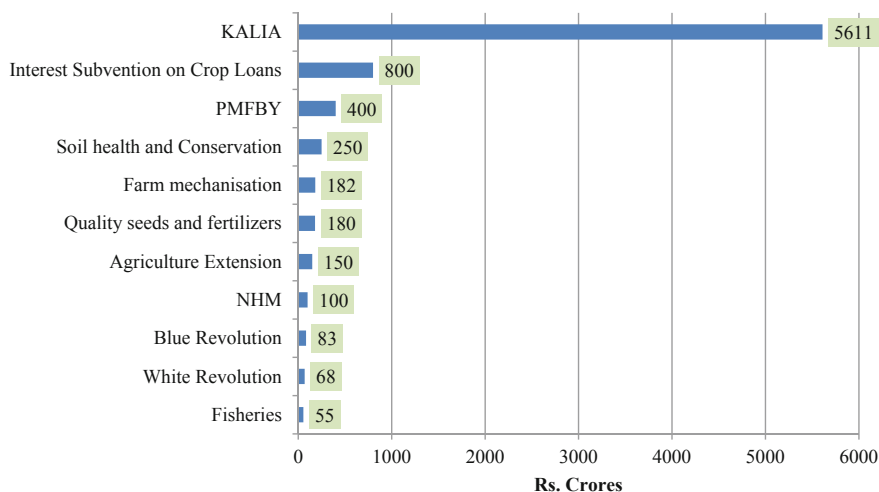


**Fig. 9.20** Budget allocation to broad heads of agriculture and allied activities. *Source* (Odisha Budget 2019–2020)



The scheme was first announced during the vote on account budget in February 2019 in the run-up to the assembly elections when Rs. 4461 was allocated. The scheme has five components: (i) financial support of Rs. 25,000 to every small and marginal farmer family over 5 agricultural seasons for cultivation; (ii) livelihood support of Rs. 12,500 for each landless agricultural household over three years for activities related to rearing goats, sheep and poultry, fishery, bee-keeping and cultivation of mushrooms; (iii) financial assistance of Rs. 10,000 per family of vulnerable agricultural households (comprising persons in old age or with disabilities); (iv) life insurance premium support to cultivators and landless agricultural labour; and (v) interest-free loans to farmers up to Rs. 50,000. The scheme has been lauded by policymakers, economists and academicians alike for its inclusiveness and prompt payment (The Odisha Gazette 2018).

While a major chunk of this year's agriculture budget has been allocated for KALIA, there are other ongoing centrally sponsored and state government schemes for which allocations have been provided in this budget as shown in Fig. 9.21. First, Rs. 800 crore has been provided for interest subvention on crop loans to co-operative as well as commercial banks in order to provide credit at an effective interest rate of 1% to farmers for loans up to Rs. 50,000 and 2% for loans above Rs. 50,000. Next, Rs. 400 crore has been allocated towards premium as the state's share for the *Pradhan Mantri Fasal Bima Yojana* (PMFBY), which is the Government of India's crop insurance scheme that provides comprehensive risk coverage for pre-sowing to post-harvest losses due to non-preventable natural risks. Further, Rs. 250 crore has been allotted for the soil health and conservation programme to open mobile soil testing laboratories and issue soil health cards. To popularise agricultural implements and equipment, Rs. 182 crore has been allotted for farm mechanisation and to procure



**Fig. 9.21** Outlays on major agricultural schemes in Odisha's agricultural budget 2019–20. *Source* (Odisha Budget 2019–2020)

and distribute quality seeds and fertilisers to farmers. The outlay for agricultural extension has been Rs. 150 crore. This is to provide farmers with the latest technology and improved agronomic practices. Another Rs. 100 crore has been provided for National Horticulture Mission and Rs. 55 crore for the development of brackish water aquaculture, marine fisheries, intensive aquaculture and inland fisheries. For the development of the fisheries and dairy sectors, Rs. 83 crore and Rs. 68 crore respectively have been allocated under the blue and white revolutions (Odisha Budget (2019–20)).

A major food security scheme of the state, wherein the state government provides 5 kg of rice per month per beneficiary at Re. 1/kg, was introduced as many deserving households were not covered under the Government of India's National Food Security Act.

## 9.6 Conclusions and Policy Recommendations

Odisha is an agrarian state with 55% of its workforce (45% according to the Labour Bureau, 2015–16) directly or indirectly involved in agriculture and allied sectors for employment (NSS 68th round 2014). Frequent famines and flooding have caused havoc in the state, leading to volatile agriculture growth over the past two decades. The regression results for Odisha show that irrigation, roads and diversification play an important role in the growth of agricultural GDP. In this section, we recommend interventions in the following areas to enable Odisha to achieve stable and robust agricultural growth for the benefit of the small and marginal farming community, who are 93% of the total farming community in Odisha.

### Infrastructural Development

1. *Development of Irrigation Infrastructure:* Our analysis in this chapter suggests that irrigation is the most important driver of agricultural growth in Odisha. As the state has among the lowest gross irrigated area in India, there is a need to develop irrigation facilities. Out of 8.8 m ha of ultimate irrigation potential (UIP) in Odisha, 5.6 m ha or 64% had been created until 2016–17. The state is targeting the completion of eight medium/major projects by December 2019 under the PMKSY-AIBP. However, only 3.6 m ha or 64% of IPC (irrigation potential created) has been utilised so far. In fact, the share of utilisation in IPC (share of IPU over IPC) has been declining since 2007–08. In order to bridge this gap between IPC and IPU, there is a need for comprehensive action to construct field channels in major and medium projects, restore distribution systems where they are in disrepair and rejuvenate tanks. In terms of groundwater, only 30% of the total potential of 16.7 lakh bcm has been used so far for different purposes, especially for irrigation.
2. *Enhancing Power Consumption in Agriculture:* To increase the utilisation of groundwater resources for irrigation purposes, power is an important input. Assured and uninterrupted power supply for agriculture also helps in operating

agricultural machinery and equipment. Odisha has the lowest power intensity among all major states in the country. Even though power sales to the agriculture sector have increased during recent years (2014–15 to 2016–17), it remains inadequate especially during the peak demand season; it is also characterised by high voltage fluctuations and frequent load shedding. Considering the poor power situation in Odisha in terms of power sales/consumption in the agricultural sector, the government needs to focus on improving transmission and distribution infrastructure. Efforts should be made to utilise separate feeders for power for agricultural purposes. The state should take full advantage of the funds being made available by the Government of India under the *Deen Dayal Upadhyay Gram Jyoti Yojana* (DDUGJY). Improving the power situation will also encourage the food processing sector to expand in the state. Further, solar energy as a sustainable form of energy has huge potential, especially for agricultural use in the form of solar pumps and solar-based irrigation systems.

3. *Increasing Coverage of Surfaced Roads*: The total coverage of roads in Odisha is 2.9 lakh km of which 77% consists of rural roads. While Odisha's total road density is higher than the all-India average, it lags behind in terms of surfaced road density. Odisha has one of the lowest surfaced road lengths in India. In 2011–12, only 23.9% of the total roads in Odisha were surfaced as compared to Gujarat and Punjab (89%), Uttar Pradesh (77%), Madhya Pradesh (61.5%) and Bihar (47.2%). Since Odisha is subjected to frequent floods, the state needs to increase the coverage of concrete roads that are more durable than black topped roads in regions where submergence is a frequent occurrence. Increasing the coverage of surface roads in the state will go a long way in ensuring efficient movement of agricultural inputs and products.
4. *Drought-proofing rain deficient areas* : Odisha needs to undertake a serious watershed management programme for drought-proofing areas frequently affected by deficient rains. Action is needed also in the context of adaptation to climate change, which is expected to increase the frequency and severity of events when climate extremes are experienced. Soil and water conservation practices are the main elements of the watershed management programme. Some of these practices are aimed at increasing soil moisture availability within agricultural fields by constructing contour *bunds*, graded *bunds*, field *bunds*, or by building terraces or furrows. Other practices such as the construction of check dams, farm ponds, gully control structures and excavation of pits across the stream channel are aimed at harvesting a substantial amount of runoff and for increasing groundwater recharge.

## Crop Husbandry

5. *Adopting Crop Rotation/Multi-Cropping*: A large part of Odisha is mono-cropped with rice, and remains fallow after harvest during the *rabi* season. The practice of monoculture has a huge disadvantage in the form of loss of nutrients, vulnerability to diseases, soil erosion and water loss that occurs due to planting the same crop each year. Crop rotation or multi-cropping by growing a variety of crops

like pulses, coarse cereals and oilseeds on the same field will not only help in retaining micronutrients in the soil but will also help increase farmer's income from a diversified crop basket. It is imperative to reduce the dependence of farmers on a single crop, as the recurring climatic anomalies make agricultural production in the state doubly risky. A second crop of oilseeds, pulses, vegetables and fodder crops can be raised through greater use of groundwater resources including through the deployment of solar pumps.

6. *Adopting improved rice varieties*: Rice continues to be an important crop in terms of acreage and production but its productivity has not kept pace with the rest of the country. It has been particularly affected by recurring droughts and floods. To promote stress-tolerant varieties and improve productivity, drought-tolerant varieties of paddy like *Sahabnagi Dhan* in Western Odisha and submergence tolerant varieties like *Swarna* sub-1 in Coastal Odisha should be popularised through the extension network.
7. *Reforming Horticulture Sector*: Horticulture, especially fruits and vegetables, represents the largest component of the value of agricultural output in Odisha. It is also the largest source of growth in the state's GVOA. Horticultural commodities, being high-value crops, generate higher income for lakhs of small and marginal farmers. Hence, the state government should promote best practices like precision farming through extension services to enhance the productivity of fruits and vegetables.

## **Animal Husbandry and Fisheries**

8. *Livestock and Dairy Development*: With the increase in the dominance of the livestock sector, increased attention needs to be given to enhancing the productivity of milk through health and reproduction management. The productivity of milk in the state is as low as 0.5 mt per female animal as compared to Punjab's productivity of 2.4 mt per female animal, Gujarat's 1.1 mt per female animal and Uttar Pradesh's 1.0 mt per female animal. The low productivity of milch animals in Odisha is despite the fact that the best germplasm is being used in the state for artificial insemination and cross-breeding. In this situation, in order to increase productivity, farmers need to reduce the herd size so that milch animals constitute a higher proportion. To achieve this, the state needs to adopt cutting edge reproduction management technologies, such as sex-sorted semen. With improved productivity, the state will become a more competitive supplier of milk in the country and will be able to sell the product in the domestic market. To strengthen the dairy industry in Odisha, there is a need to set up more dairy co-operative societies, collection centres and processing facilities. Linking farmers with the organised milk processing sector through producer-owned dairy co-operatives will make dairy farming more sustainable for Odisha farmers.
9. *Expansion of the Fisheries Sector*: The fisheries sector holds an important place in the state's economy due to its long coastline and the presence of lakes. For further development of inland fishery, brackish water fisheries and fresh water fisheries from tanks, ponds, swamps, lakes, reservoirs, rivers and canals, government

should encourage public-private partnerships. Government should also promote the adoption of *makhana*, and water chestnut in addition to combining other crops with fisheries and livestock farming. These can be promoted in the available large wet lands of Odisha, ensuring enhanced income generation for farmers.

## Storage and Processing Infrastructure

10. *Food Processing Infrastructure:* Processing of food is a form of value addition that not only increases the shelf life of food through dehydration, but also enhances the nutritive value of food by making food more nutritious and healthy. However, Odisha lacks processing infrastructure in the food sector. The establishment of food parks with efficient physical infrastructure facilities like power, water supply and drainage can facilitate the setting up of cold storages, refrigeration plants, pulping plants, dehydration plants and food manufacturing plants with the active participation of private players. This will not only help reduce wastage, but will also help absorb surplus agricultural commodities in the market. To establish food processing industries, a pre-requisite is an improvement in the power situation in the state in terms of both quality and quantity.

## Annexure

See Tables 9.3 and 9.4.

**Table 9.3** Description of variables

Variable	Variable Name	Description
GSDPA	GSDP from agriculture	Gross State domestic product from agriculture and allied sectors for Odisha, gross value added at basic prices from 2011–12 onwards
TOT (AS)	Terms of trade (agri/services)	Terms of trade between agriculture & allied activities to services
TOT (AN)	Terms of trade (agri/non-agri)	Terms of trade between agriculture & allied activities to non-agricultural sector (industry + services)
IR	Irrigation ratio	Ratio of gross irrigated area to gross cropped area as %
Seed	Quality seed	Quality seed distribution
Ferti	Fertiliser consumption	Fertiliser consumption per hectare
Road	Road density	Total road density (Per 100 Km <sup>2</sup> )
Livestock	Livestock	Share of livestock to value of output from agriculture and allied activities

**Table 9.4** Correlation matrix

	Lnngsdpa	Lntotai	Lntotas	Lntotan	Lnir	Lnseed	Lnferti	Lnpower	Lnroad	Lnfv	Lnlivestock
Lnngsdpa	1										
Lntotas	<b>0.8062***</b>	-0.1556	1								
Lntotan	<b>0.4549*</b>	0.385	0.8422***	1							
Lnir	<b>0.8971***</b>	-0.5379**	0.7211***	0.4267*	1						
Lnseed	<b>0.8401***</b>	-0.3479	0.7588***	0.4973*	0.7168***	1					
Lnferti	<b>0.8033***</b>	-0.5741**	0.5828**	0.2622	0.7322***	0.8398***	1				
Lnroad	<b>0.791***</b>	-0.3187	0.8145***	0.5442**	0.6434***	0.8333***	0.5978**	0.3449	1		
Lnlivestock	<b>0.8144***</b>	-0.5324**	0.6962***	0.3492	0.6714***	0.8753***	0.8207***	-0.035	0.8229***	-0.6596***	1

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