

# **Working Paper 337**

## **Transforming Agriculture in Odisha: Sources and Drivers of Agriculture Growth**

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## **Acknowledgement**

This paper forms a part of the study on Agricultural growth and its linkages to poverty alleviation in six selected states of India, namely Bihar, Uttar Pradesh (UP), Odisha, Punjab, Gujarat and Madhya Pradesh (MP). Bihar, UP and Odisha have experienced low to moderate growth in agriculture over the period 2000-01 to 2014-15. Punjab has been the seat of green revolution and was a front-runner in agriculture during late 1960s, but slipped to low levels of agri-growth in recent period. Gujarat and Madhya Pradesh have shown some extra-ordinary growth in their agriculture sectors (almost three times the all India agriculture growth) in the last decade or so. The key idea of this study was to look for policy lessons from each other within Indian context, and see how to propel growth in agriculture for faster alleviation of poverty.

We gratefully acknowledge the financial support provided by the Bill and Melinda Gates Foundation for this important project. In particular, we would like to thank Mr. Hari Menon, Mr. Brantley Browning and Dr. Purvi Mehta from the BMGF for their very productive and constructive interaction from the very conception of the project, and their suggestions as the project evolved. We would also like to thank Mr. Manoj Ahuja, Principal Secretary, Department of Agriculture and Farmer's Empowerment, and Mr. Bishnupada Sethi, Commissioner-cum-Secretary Fisheries and Animal Resources Development Department for useful interactions on various issues. We also express our appreciation to Mrs. Kirti Saxena, Senior Advisor, Ministry of Road Transport and Highways for validating data on roadways. We would also like to express our gratitude to Mr. Siraj Hussain, former Secretary of Agriculture and Farmers' Welfare and Mr. Bhallamudi Sridhar, Faculty, Bankers Institute of Rural Development for their invaluable comments and suggestions. We are also thankful to the participants of the "Workshop on studying drivers of agricultural growth in selected Indian state with focus on role of agricultural extension systems", held in Delhi on June 17, 2016 and the participants of the "Odisha Government partners and BMGF Roundtable Discussion", held in Bhubaneswar on September 29, 2016.

## Abstract

Odisha is one of the poorest states in the country, with around 36 per cent of the rural population living below the poverty line. Ninety one per cent of poverty in Odisha is rural and more than 60 per cent of its workforce is engaged in agriculture. During the five years from 2010-11 to 2014-15, the contribution of agriculture to the state GDP recorded an annual average growth of a mere 0.9 per cent. This paper studies the composition, sources and potential drivers of agriculture growth in Odisha with a view to identifying the factors for the state's poor performance in the sector. In light of the findings, it makes three principal recommendations to stimulate agricultural growth in the state. viz., expansion of irrigation facilities, increase in the intensity of surfaced roads in rural areas and diversification of production portfolio towards high value commodities. The main scope for expanding irrigation lies in the largely untapped ground water resources; this requires that quality and quantity of rural power supply be improved by strengthening transmission and distribution and separating the feeders for irrigation. The proportion of surfaced roads in the state is one of the lowest in the country and needs attention to link farmers to markets. The state is already making progress towards the development of the livestock sector and the production of fruits and vegetables but the process needs to be accelerated through extension services.

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**Keywords:** *Agricultural Growth, Irrigation, Power, Surfaced Roads, Agriculture Diversification, Odisha*

**JEL Classification:** *Q10, Q15, Q25*

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## Executive Summary

Odisha is one of the few states that have enjoyed a long period of political stability and continuity in economic policies since March 2000. Odisha is also blessed with abundant natural resources, especially minerals, forests, and ground water. Given all this, Odisha should have been one of the richer states of India. But ironically, it is not. Its per capita income is the fifth lowest, and poverty the sixth highest among Indian states.

Odisha's per capita income (Rs 24,928 in FY14) hovered around 62 per cent of the all-India average (Rs 39,904 in FY14). Although this is much better than that of Bihar (Rs 15,506) and Uttar Pradesh (Rs 19,233), it remains way below the top performing states like Sikkim (Rs 83,527), Maharashtra (Rs 69,097), Haryana (Rs 67,260) and Gujarat (Rs 63,168). In terms of poverty, one-third of Odisha's population is poor, compared to 22 per cent at the all-India level and just 7 per cent in Kerala, 8 per cent in Sikkim and Punjab, 11 per cent in Haryana, and 16 per cent in Gujarat (all figures are for the year 2011-12, as per erstwhile Planning Commission estimates based on the Tendulkar poverty line).

Earlier research by the World Bank (World Bank Report, 2008) shows that high agricultural growth is the key to quick poverty alleviation. This is particularly so, as 91 per cent of poverty in Odisha is rural and more than 60 per cent of its workforce is engaged in agriculture. But unfortunately, during the five years from 2010-11 to 2014-15, the contribution of agriculture to the state GDP recorded an annual average growth of a mere 0.9 per cent, compared with a robust 14.2 per cent in Madhya Pradesh and 7.1 per cent even in Bihar. Keeping this background in mind, this paper has used secondary data published by the central and state governments to study the composition, sources and drivers of agriculture growth in Odisha with a view to identifying the factors for the state's poor performance in the sector.

We find that rice continues to be the most important crop in terms of acreage with around 46 per cent of gross cropped area (GCA) devoted to the crop. However, its productivity is one of the lowest in the country, standing at less than 2MT/ha, while productivity in Punjab is 4MT/ha, Haryana 3.2MT/ha and Andhra Pradesh 3MT/ha. However, on a positive note, the study finds that in recent years, there has been a transformation in Odisha's production portfolio in favour of high value commodities. In particular, there has been remarkable increase in the production of livestock commodities, such as milk, meat and eggs. The share of fruits, vegetables and livestock in the total value of output from agriculture and allied active has increased from 36.2 per cent in triennium ending<sup>1</sup> (TE) 1992-93 to 45.9 per cent in TE 2013-14.

For sustained agriculture growth, better control over water, especially irrigation is vital. About 39 per cent of Odisha's gross cropped area is irrigated (compared to the all India average of 48 per cent and an average of above 95 per cent in the Punjab-Haryana belt).

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<sup>1</sup> For a trend analysis, we use a moving average of three years (Triennium Ending average) to even out the annual fluctuations in data

Odisha has large (70 per cent) untapped groundwater potential and about 50 per cent untapped potential from major and medium irrigation schemes. While lack of irrigation is holding back agricultural growth in Odisha, assured access to water can be a boon tomorrow with some strategic interventions. Luckily, much of Odisha's groundwater reserves are at a depth of just 2 to 5 metres, which can be tapped economically if there were ample power supply to the agriculture sector. Unfortunately, Odisha supplies only 1.3 per cent of its total power supplies to agriculture, resulting in a meagre consumption of less than 20kwh/ha, compared to 766 kwh/ha at the all India level, 1,742 kwh/ha in Tamil Nadu and 1456kwh/ha in Punjab! Such a situation typically arises when supplying power to agriculture through the grid increases the losses of discoms as power tariffs for agriculture are generally zero or are highly subsidised. Diesel turns out to be too expensive for farmers. In such a situation, almost a million hectares of land remains fallow. The solution may lie in the large scale installation of solar irrigation pumps, which can now supply power at Rs 4.50 to Rs 6 /kwh. Odisha receives solar radiation of around 5.5 kwh/sq m and 300 days of clear sunny days. Solar power in rural areas can also help build value chains, including cold storages, for high-value agriculture, especially milk and fruits and vegetables, in which Odisha has done relatively better. Moreover, untapped ground water resources can also be utilized by improving the quality and quantity of rural power supply by strengthening transmission and distribution and obtaining separation of feeders for irrigation.

The next critical thing for Odisha to focus on is paved roads. Roads provide linkages to the output and input markets, increase the mobility of labour, and help increase returns to farmers. As per Odisha's Economic Survey (2014-15), surfaced roads as a percentage of total road length in Odisha remained in the range of 20-30 per cent, compared to almost 90 per cent in Gujarat, Punjab and Haryana. In fact, almost 46 per cent of villages in Odisha do not have all weather road connectivity. This severely hampers the ability of farmers to get the best price for their produce and inputs.

The third factor to focus on is the incentivisation of faster diversification of agriculture towards high value products such as livestock and fruits and vegetables, and the promotion of well-co-ordinated value chains, such as AMUL in the case of milk and Venketshwera/Sugana hatcheries in the case of poultry.

Just these three interventions, tapping groundwater irrigation through assured power supply, providing paved roads, and incentivising diversification towards high value agricultural products, can bring rich dividends and alleviate poverty in Odisha much faster. In the paper, we have used a simple ordinary least square model and Engel-Granger test of cointegration to show that irrigation, road development and diversification can drive agricultural growth in Odisha.

# **Transforming Agriculture in Odisha: Sources and Drivers of Agriculture Growth**

Anwarul Hoda, Pallavi Rajkhowa and Ashok Gulati

## **1. Introduction**

Odisha, located on the eastern seacoast of India, spans over 15.6 million hectares of land and comprises around 3.2 per cent of India's population (44.7 million people). The state is one of the poorest in the country, with around 36 per cent of the rural population living below the poverty line as compared to the national average of 26 per cent. Further, the state's per capita income in 2013-14 was the fifth lowest, standing at only Rs 24,928 as compared to the national average of Rs 39,904. Odisha is largely a rural economy, with 83 per cent of the population living in rural areas as compared to the all-India figure of 69 per cent.

Like the rest of the country, there has been a structural transformation in Odisha, with the share of agriculture in total gross state domestic product (GSDP) falling from 36 per cent in TE 1992-93 to 15.4 per cent of total GSDP in TE 2013-14 and that of services and industry increasing. Despite this decline in the share of the sector in total GSDP, it continues to be one of the main sources of livelihood in the state. Around 62 per cent of the total work force is dependent on agriculture for their livelihood, directly or indirectly in comparison to the national average of 55 per cent (Census, 2011).<sup>2</sup> However, the gross cropped area per 100 persons in Odisha is only 12.3 hectares as compared to 31.1 hectares in Madhya Pradesh, 20.9 hectares in Gujarat and 28.4 hectares in Punjab, leading to greater pressure on land.

Given its high dependence on agriculture, the development of this sector can play an important role in the overall development of the state. As per the World Development Report (2008), GDP growth originating in agriculture is at least twice as effective in reducing poverty compared to GDP growth originating outside agriculture. However, agricultural growth in Odisha has been low and extremely volatile. From 2005-06 to 2014-15, agricultural growth in Odisha was 2.4 per cent per annum as compared to the national average of 3.6 per cent per annum. In the same period, Madhya Pradesh, once a BIMARU<sup>3</sup> state, recorded a robust agriculture growth of 9.7 per cent and Bihar, considered a low performing state, registered an agricultural growth rate of 4.7 per cent. Odisha's comparative agriculture performance in the last five years (2010-11 to 2014-15) was poor. The agriculture sector recorded a mere 0.9 per cent growth as compared to a robust 14.2 per cent growth in Madhya Pradesh and 7.1 per cent in Bihar. These numbers should be read in the context of the

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<sup>2</sup> NSS 2011-12 reports the proportion of Odisha's agriculture workforce as 55.7% and all India average as 49%

<sup>3</sup> BIMARU is an acronym formed from the first letters of the names of the Indian states of Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. This was used to refer to the poor economic conditions within those states.

frequent natural disasters, specifically flooding and cyclones in coastal areas and acute drought in the western regions of the state, which have negatively affected agricultural growth over the past two decades. Between 1991 and 2012, there were floods in 12 years out of 22 years and droughts in 8 out of 22 years in the state. The entire coastal line, extending over 482 km, is exposed to flooding and water logging. Drought is unpredictable in Odisha; in some years, drought has affected the entire state, while in others, only a few districts have been affected. These trends are extremely worrisome for a state like Odisha where agriculture is the largest source of employment. While natural disasters have undoubtedly affected the agricultural performance of the state, there may be other important contributory factors for its poor agricultural development. This study analyses the composition, sources and potential drivers of agricultural growth in Odisha with a view to identifying these factors.

In section 2, we first discuss the data sources and methodology used in the study. In section 3, we give a description of the geographical and demographic characteristics of Odisha and Odisha's agricultural landscape. In section 4, we examine the composition of the agricultural sector in the state and the main sources of agricultural growth. In Section 5, we discuss the potential drivers of agriculture growth using econometric analysis. Based on this analysis we identify other contributory factors behind the poor agricultural performance of the state. Section 6 concludes with recommendations of policy interventions that would stimulate agricultural growth in the state.

## **2. Data and Methodology**

The study has used secondary time-series data compiled from various published sources of the Government of India and Odisha Government. The study covers a period of two decades from 1990-91 to 2013-14. We have used descriptive analysis to compare the performance of Odisha vis-à-vis other states. For comparison, we have selected two subsets of three comparator states each: the first comprising Gujarat, Madhya Pradesh and Punjab, and the second comprising Bihar, Odisha and Uttar Pradesh. The rationale for selecting these states is that Gujarat and Madhya Pradesh have experienced rapid agricultural growth in the past decade while Punjab has historically performed well during the green revolution. Bihar, Odisha and Uttar Pradesh are considered laggard states due to their poor agricultural growth and high poverty rates.

To analyse the 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 livestock. To determine the sources of growth, we have we have deflated the current series of each segment by the WPI at 2004-05 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 gross value of output from agriculture and allied activities (GVOA).

To determine the drivers of growth, we use a three-step procedure to estimate the relationship between agricultural growth and selected explanatory variables. In the first step, we test if the natural logarithm of the selected variables is integrated of the same order using the

Augmented Dickey Fuller (ADF) test. Depending upon the outcome of the tests, the second stage involves determining if the series are co-integrated (i.e., testing for a long term relationship between the variables) using Engle and Granger's (1986) two-step residual based procedure. We use this method because we are interested in the elasticity of the explanatory variables. Accordingly, we first run a simple ordinary least square model to analyse the determinants of agricultural growth in Odisha and then perform a unit root test on the residuals of the model to determine if it is stationary. The null hypothesis in the Engle-Granger procedure is no co-integration and the alternative is co-integration.

### **3. Agriculture in Odisha**

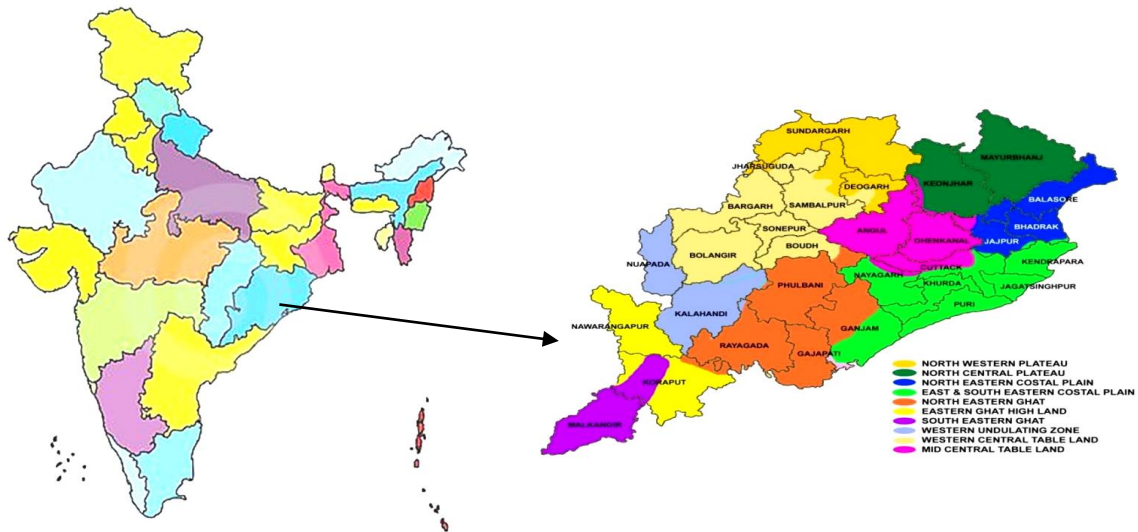
#### ***3.1 Odisha in the Context of India***

Odisha is spread over an area of 156 thousand sq km and is divided into four geographical regions – the Northern plateau, central river basins, eastern hills and coastal plains – and ten agro-climatic zones.<sup>4</sup> The state's population in 2011 was 41.9 million, which has been projected to have grown to 44.7 million in 2016, accounting for about 3.2 per cent of India's population. Around 83 per cent of this population lives in rural areas as compared to the national average of 68.8 per cent, making Odisha a largely rural economy. Like the rest of the country, the state has undergone a structural transformation by moving away from agriculture towards non-agricultural sectors. The share of agriculture in total GSDP has fallen by half since the 1990s, from 36 per cent to 15.4 per cent, while those of industry and services have increased (Table 1). Despite this decline, the agricultural sector continues to be a key sector in Odisha due to its strategic importance to food security, employment generation and poverty reduction. Around 62 per cent of the total workforce consists of agricultural workers as compared to the national average of 55 per cent (Census 2011). Amongst the comparator states, Bihar (74 per cent) and Madhya Pradesh (70 per cent) have higher a dependency on the agricultural sector in terms of employment as compared to Odisha.

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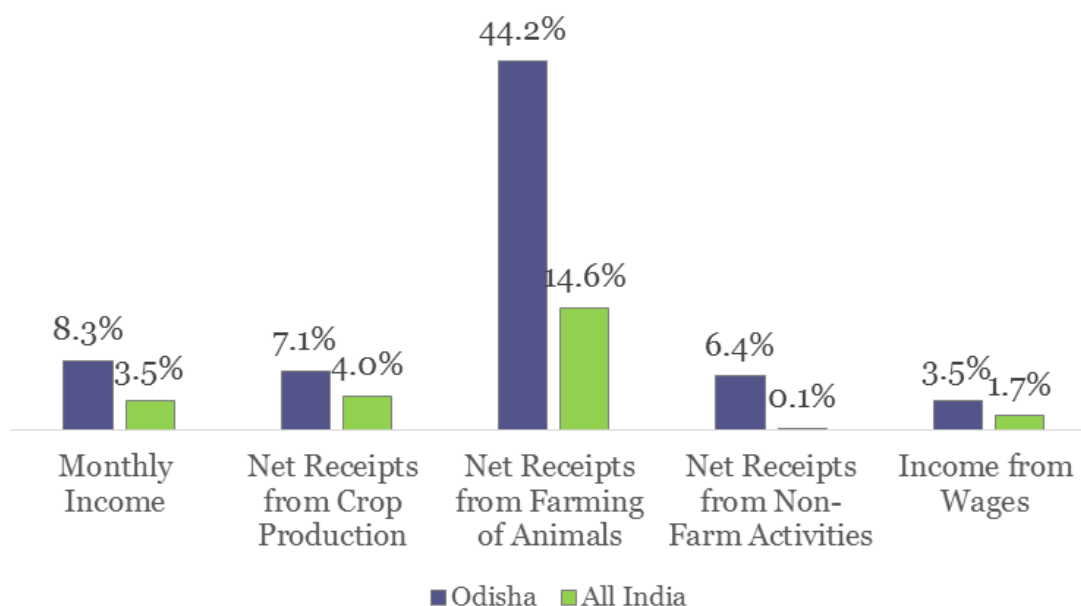
<sup>4</sup> Agro-climatic zones: 1. North western plateau, 2. North central plateau, 3. North eastern coastal plateau, 4. East & south eastern plateau, 5. North eastern ghat, 6. Eastern ghat high land, 7. South eastern ghat, 8. Western undulating, 9. Western central table, 10. Mid central table land

**Figure 1: Odisha in the context of India**



In addition to being a rural economy with high dependency on agriculture for employment, Odisha is also one of the poorest states in the country. It ranks fifth in terms of rural poverty after Chhattisgarh (45 per cent), Jharkhand (41 per cent), and Arunachal Pradesh and Manipur (39 per cent each). Around 36 per cent of the rural population lives below the poverty line as compared to the national average of 26 per cent. Further, the state's per capita income in 2013-14 was only Rs 24,928 as compared to the national average of Rs 39,904 and only slightly above Manipur (Rs 24,042), Assam (Rs 23,392), Uttar Pradesh (Rs 19,233) and Bihar (Rs 15,506). However, to the state's credit, Odisha has recorded the fastest decline in poverty rates from 61 per cent in 2004-05 to between 36 percent in 2011-12. Amongst other factors, one important contributory factor for this decline has been the significant increase in the importance of the livestock sector and the rise in real income from the farming of animals (Figure 2). Despite this commendable trend, a large section of the rural population continues to live below the poverty line and is dependent on agriculture and livestock as the main source of income. Therefore, the development of this sector has become an imperative to ensure food security in the state. In the following section, we discuss Odisha's agricultural landscape and trends in agricultural growth.

**Figure 2: Source-wise real growth in income between 2002-03 and 2012-13.**



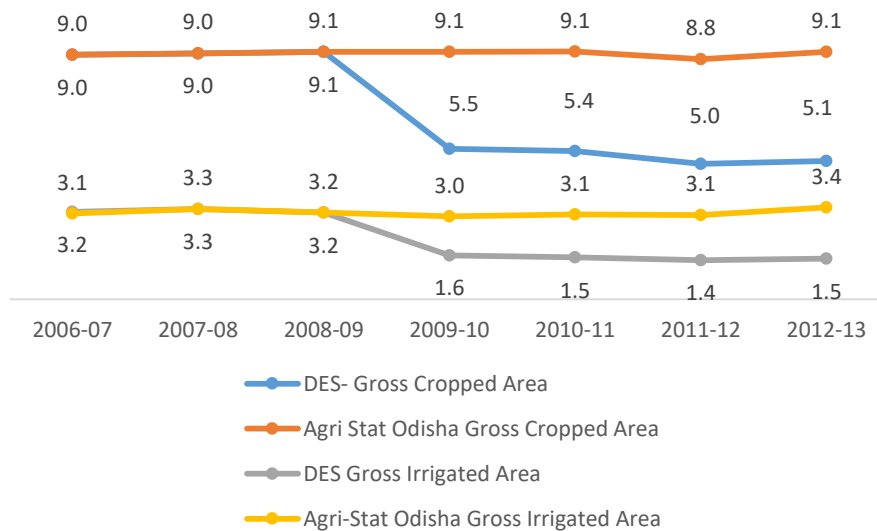
Source: NSS, 2002-03 & 2012-13

### 3.2 Odisha's Agricultural Landscape

#### 3.2.1 Land Utilisation

As demand for land has increased for different activities, land available for agricultural purposes has declined from 9.6 million hectares (TE 1992-93) to 8.9 million hectares (TE 2012-13). On the other hand, land for non-agriculture use has increased from 0.8 million hectares in TE 1992-93 to 1.3 million hectares in TE 2012-13. This decline in gross cropped area is a result of erosion, salinisation and inundation of farmlands due to frequent floods, which make the land less fertile, and due to lack of irrigation facilities during the rabi season. Here, it is important to mention that the Directorate of Economics and Statistics (DES) report a higher decline in GCA in TE 2012-13 as compared to the statistics given by Agriculture Statistics of Odisha. Figure 3 shows the discrepancy in data between the two sources. Up to 2008-09, both sources gave the same statistics but after 2008-09, there is a significant difference in data on land utilisation from the two sources. For example, as per DES, GCA in Odisha had fallen to 5.2 million hectares in TE 2012-13 while Agriculture Statistics of Odisha reported the GCA at 8.9 million hectares. Since data for Agriculture Statistics of Odisha look more reliable from 2009-10 onwards, we have used their data for the analysis from 2009-10 onwards.

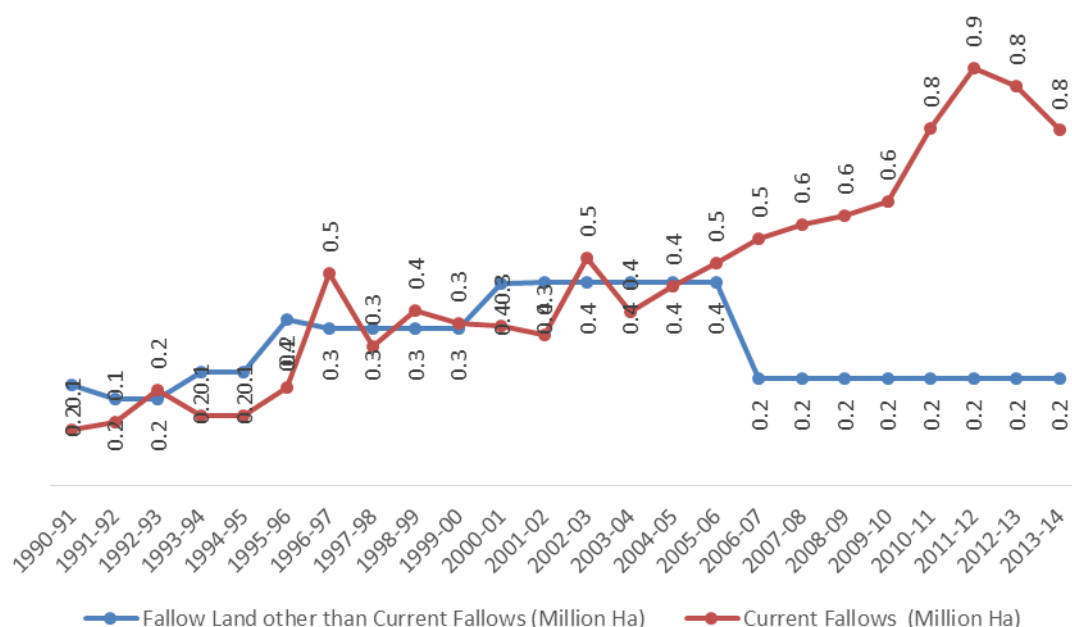
**Figure 3: Discrepancy in Land utilisation Data (Million Hectares)**



*Source: Directorate of Economics & Statistics (DES) and Agriculture Statistics of Odisha, Several Issues*

A disturbing trend in land utilisation that has emerged in Odisha is the increase in fallow land. Fallow land in Odisha increased from 0.3 million hectares in TE 1992-93 to 1.1 million hectares in TE 2012-13. Farmers in Odisha are reluctant to grow rabi crops because of scarcity of water during this season. Only 30 per cent of gross cropped area is utilised for crop production in the rabi season. Figure 4 shows the gradual increase in fallow land in Odisha since the early 1990s. The increase in fallow land is attributed to irregularities in rainfall, frequent natural calamities, and lack of adequate irrigation facilities. Moreover, in peri-urban regions, due to absentee landlords, cultivated land has been transferred for non-agricultural purposes such as construction of buildings, establishment of industrial units, establishment of commercial complexes, etc. The increase in fallow land is the highest in the Eastern and Southern Ghats, followed by the central and coastal areas. Lack of irrigation maybe an important contributory factor in increasing fallow land in the Eastern and Southern Ghats, and the central region of Odisha. These two regions have recorded an irrigation ratio of 30.0 per cent and 34.4 per cent respectively in 2013-14 as compared to the state average of 38.9 per cent. The coastal areas, on the other hand, has recorded a relatively higher irrigation ratio of 56 per cent; however, this area is prone to frequent floods and water logging.

**Figure 4: Fallow Land (Million Hectares)**

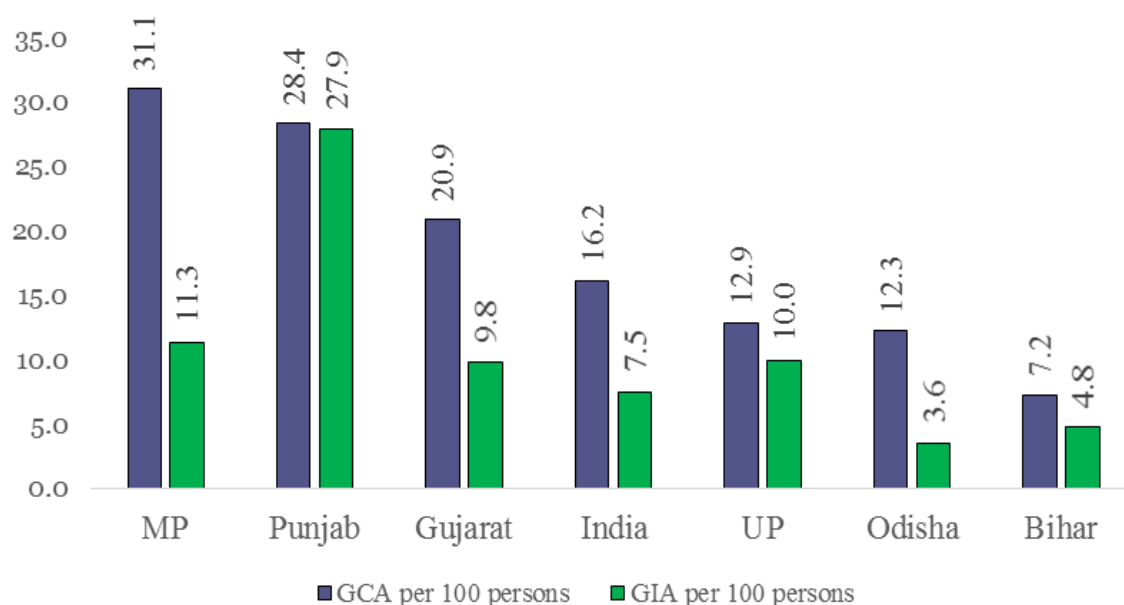


Source: Directorate of Economics & Statistics & Agriculture Statistics of Odisha

The other reason for increasing fallow land is the poor soil quality in the state. The predominant soil type in Odisha is red soil, covering around 7.1 million hectares of land i.e., 46 per cent of the total geographical area. The characteristics of red soil are low organic matter content, poor water retention capacity, low nitrogen, low phosphate, and low micronutrients such as calcium and magnesium, which are some important inputs for crop productivity. Red soil cultivation is more dependent on irrigation as compared to other soil types. Additionally, 5.5 million hectares of land (35 per cent of geographical area) is covered by mixed red and yellow soil, 1.0 million hectares by black soil, 0.7 million hectares by laterite soil, 0.7 million hectares by deltaic alluvial soil, 0.3 million hectares by coastal saline and alluvial soil and 0.2 million hectares by brown forest soil.

High rural population density, poor land quality, increased fallow land and increased use of land for non-agricultural activities have resulted in the relative scarcity of land available for farming in Odisha. Figure 5 shows that gross cropped area per 100 persons in Odisha is 12.3 hectares while that of Madhya Pradesh, Punjab and Gujarat are 31.1, 28.4 and 20.9 hectares respectively. This shows that more people are dependent on a small are of land for farming in Odisha.

**Figure 5: GCA and GIA per 100 persons (in ha) TE 2012-13**



Source: Directorate of Economics & Statistics

### 3.2.2 Cropping Pattern

Odisha is primarily a food grain growing state. Around 56.4 per cent (TE 2013-14) of its gross cropped area is used for food grain production and, within cereals, rice is the dominant crop (46 per cent of GCA). However, the area under food grains has declined from 7.8 million hectares in TE 1992-93 to 5.0 million hectares in TE 2013-14. Further, from Figure 6, it can be seen that the area for oilseeds and pulses has declined marginally. Oilseeds and pulses are mainly grown in the rabi season, and a result of the decline in acreage under these two crops has been that a large proportion of the land in the rabi season has remained fallow. On an average, only around 2.6 million hectares were cropped during the rabi season as against 5.8 million hectares cropped during the kharif season. It may be worth observing that the areas lost to oilseeds and pulses have largely not been diverted to other crops but have been left fallow. However, the area under fruits and vegetables has been rising in the 2000s,<sup>5</sup> which is a positive trend as it reflects diversification towards high value agriculture. In TE 2003-04, fruits and vegetables were grown on around 0.9 million hectares (10.7 per cent of GCA); the area under fruits and vegetables increased to 1.0 million hectares in TE 2013-14 (11.4 per cent of GCA).<sup>6</sup>

<sup>5</sup> NHB data available from 2000 onwards

<sup>6</sup> Comparable Fruits and vegetable data only available from 2000-01

**Figure 6: Area under Major Crops**



Figures for TE 2012-13 are taken from different issues of Agriculture Statistics of Odisha due to inconsistent data in DES

Source: Directorate of Economics & Statistics

### 3.2.3 Climatic Risks

Rain-fed agriculture is known to be a high risk activity. As of TE 2013-14, only 37.5 per cent of gross cropped area in the kharif season and 44.6 per cent of gross cropped area during the rabi season was brought under assured irrigation, while the remaining area was dependent on rain. In Odisha, the risk is aggravated by frequent natural disasters. The coastal districts of Odisha are exposed to floods and cyclones, while the western districts are prone to acute droughts. Moreover, a large section of the state is also prone to earthquakes. Around 80 per cent of the state is vulnerable to one of these natural disasters (National Institute of Disaster Management, 2015). As a matter of fact, the state has been declared disaster-affected for 95 of the last 105 years (Mahapatra, 2006).

Floods are a more recurrent problem faced by the state than drought. Between 1991 and 2012, there were floods in Odisha in 12 out of 21 years. The entire coastal line extending over 482 km is exposed to flood and water logging (Agriculture Department, Odisha).<sup>7</sup> In the floods of 2001, 2003, 2006 and 2008, more than 70 per cent of the districts were affected.

Droughts have affected the state to a varied extent over the years. In some years, the whole state was affected while in others, only a few districts have been affected. Odisha was

<sup>7</sup> [http://agriodisha.nic.in/http\\_public/pdf/DMP.pdf](http://agriodisha.nic.in/http_public/pdf/DMP.pdf)

affected by drought in 1992, 1996, 1998, 2000 and 2002,<sup>8</sup> 2010, 2011, 2012<sup>9</sup> and 2015.<sup>10</sup> Drought and prolonged dry periods during the non-monsoon months has reduced the flow in rivers in the state. Most rivers remain dry for around two-thirds of the year (Pati, 2010).

The western districts of Odisha covering the agro-climatic zones of the north-western plateau, western undulating zone and western central table land is highly susceptible to droughts. In 2013-14, this region accounted for around 37.2 per cent of the area under rice cultivation, 36.8 per cent of the area under pulse cultivation and 30.8 of the area under oilseeds cultivation. Only 33 per cent of gross cropped area in this region was brought under assured irrigation during the year as compared to 60.7 per cent in the north-eastern coastal plains and 53.4 per cent in the east and south-eastern coastal plains. Due to the variability of rainfall, the yield of kharif rice, which is the major crop in the state, has fluctuated widely. In drought years, there is substantial loss of production of paddy, pulses and oilseeds both during kharif and rabi.

### ***3.3 Trends in Agricultural Growth***

Agricultural growth in Odisha has been volatile and low in the last two decades. Between 2000-01 and 2014-15, the state's agricultural growth rate was only 2.4 per cent, lower than the national average of 3.6 per cent (Figure 7).

In the 1980s, the annual agricultural growth rate in the state was 4.4 per cent (Table 7), which fell in the decade of the 1990s when Odisha recorded a negative growth rate. This was an alarming development, given the dependence of Odisha on the agricultural sector. The decline was caused mainly by successive natural calamities, severe droughts in 1996 and 1998 and Cyclone 05B or Paradip Cyclone in 1999. In the 2000s, there were ups and downs in the agricultural growth rate in the state, influenced mainly by climatic factors, as depicted in Figure 8, but the final result remained modestly positive. In 2002-03, Odisha experienced a severe drought in 18 districts and partial drought in 12 districts. That year was marked as a drought year at the all-India level with a seasonal rainfall deficit of 21.5 per cent. Despite the improvement in agricultural growth in the decade of the 2000s, Odisha's agriculture growth was one of the lowest in the country. As Figure 7 shows, in the period 2000-01 to 2014-15, Odisha's agricultural growth rate at 2.4 per cent was lower than most states in India except Kerala, Punjab and West Bengal. In the same period, Madhya Pradesh, once a BIMARU state, recorded a robust agricultural growth rate of 9.7 per cent and Bihar, considered a low performing state, grew at 4.7 per cent. Odisha's comparative performance in the last five years (2010-11 to 2014-15) is even worse. The agricultural sector recorded a mere 0.9 per cent growth as compared to a robust 14.2 per cent growth in Madhya Pradesh and 7.1 per cent in Bihar.

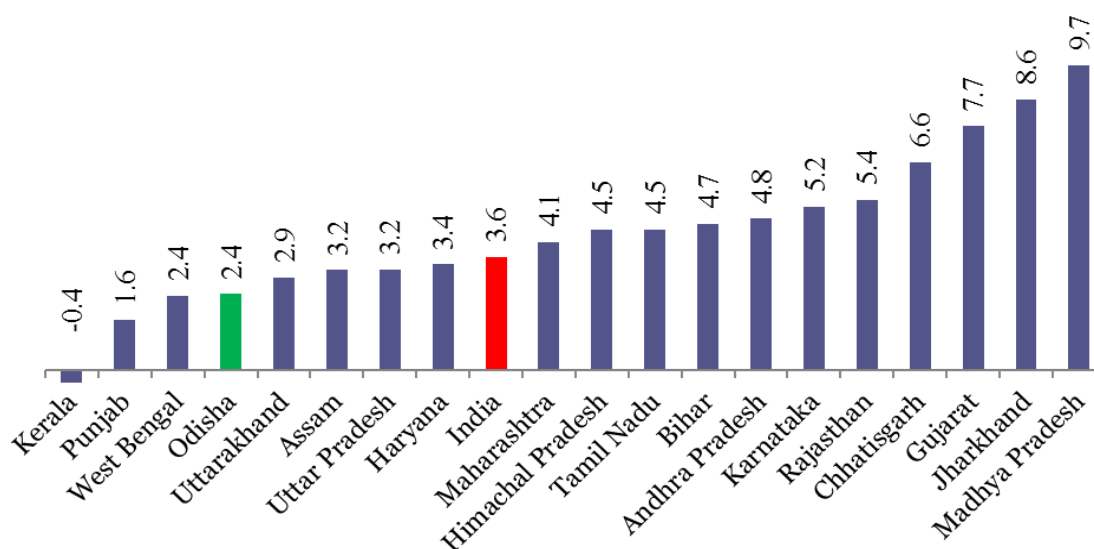
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<sup>8</sup> [http://agriodisha.nic.in/http\\_public/status%20of%20agriculture%20in%20orissa.aspx](http://agriodisha.nic.in/http_public/status%20of%20agriculture%20in%20orissa.aspx)

<sup>9</sup> [http://agriodisha.nic.in/http\\_public/pdf/DMP.pdf](http://agriodisha.nic.in/http_public/pdf/DMP.pdf)

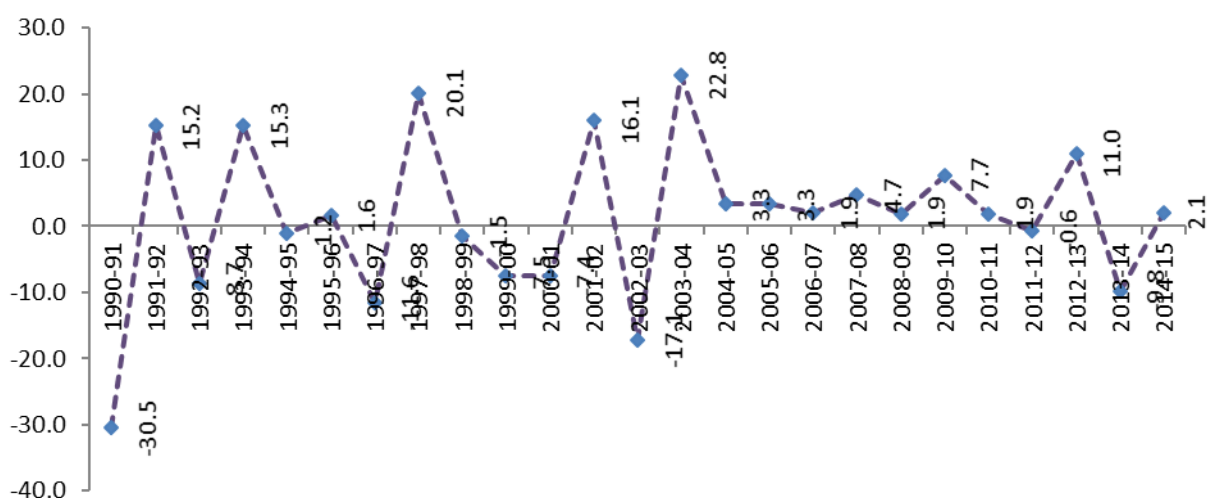
<sup>10</sup> [http://www.business-standard.com/article/current-affairs/14-deficient-rainfall-caused-drought-in-odisha-115102701194\\_1.html](http://www.business-standard.com/article/current-affairs/14-deficient-rainfall-caused-drought-in-odisha-115102701194_1.html)

**Figure 7: State-wise Agriculture Growth Rate (2005-06 to 2014-15)**



Source: Government of India, Central Statistical Organization. GSDP at Factor cost in 2004-05 prices

**Figure 8: Trend in Agriculture growth in Odisha**



Source: Government of India, Central Statistical Organization. GSDP at Factor cost in 2004-05 prices

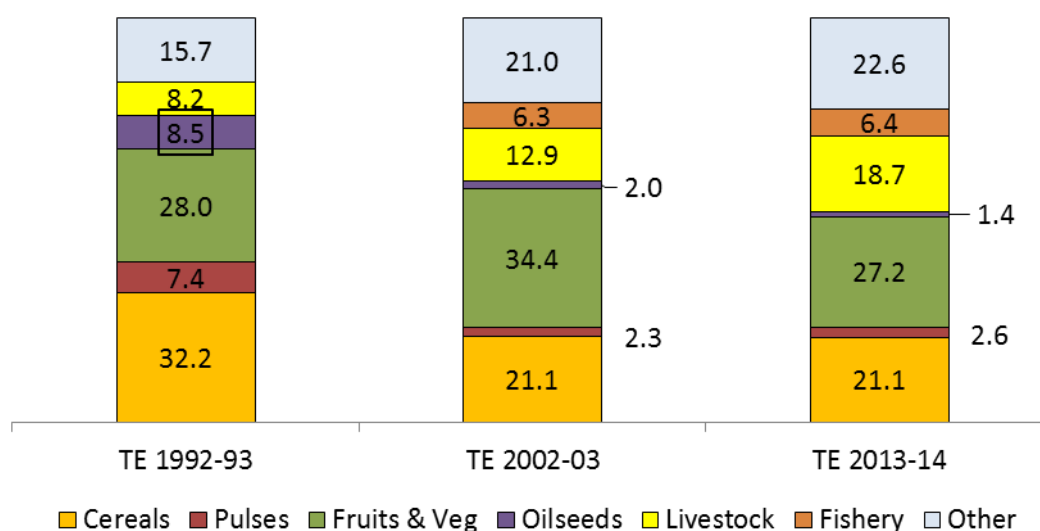
#### 4. Composition and Sources of Agriculture Growth

To analyse the composition of agriculture in Odisha, 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 (at current prices) and to determine the sources of growth, we have deflated the current series of each segment by the WPI at 2004-05 prices and then decomposed year-on-year growth in GVO of 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.

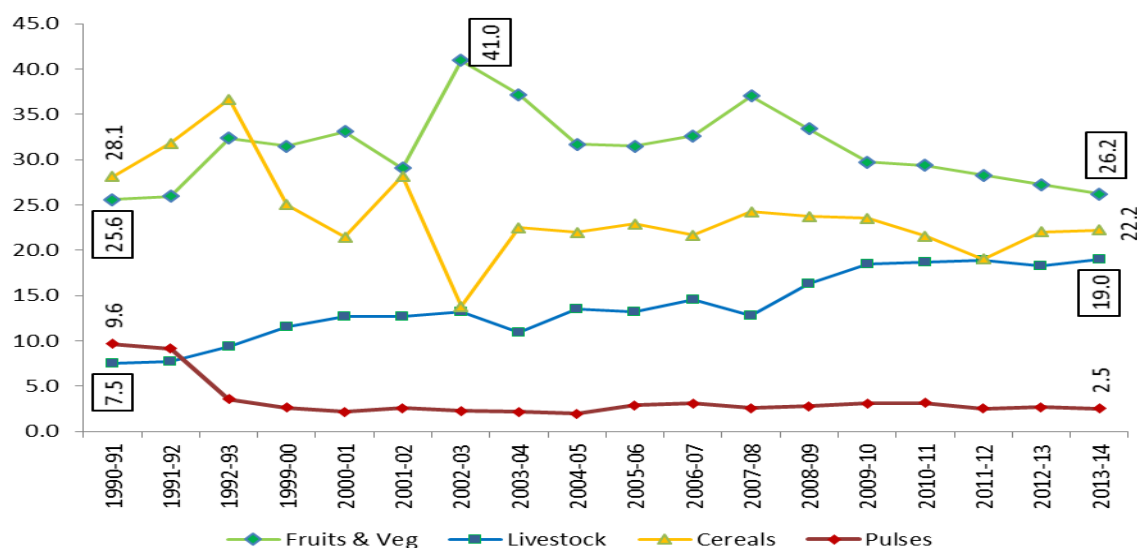
Odisha is predominantly a food crop growing state. Non-food crops such as oilseeds, fibres and sugar constitute only 2.6 per cent of the total value of output from agriculture and allied activities (TE 2013-14). Figure 9 highlights the changing composition of Odisha's agrarian economy with fruits, vegetables, floriculture and livestock expanding their share at the expense of food grain crops and non-food crops. Although rice continues to be the dominant crop grown in Odisha in terms of acreage, the structure of the agricultural sector in the state in value terms has gradually moved away from food grains towards high-value commodities, especially meat, milk and fruits/vegetables/floriculture. This is a positive trend as studies have shown that high-value commodities such as fruits, vegetables, milk, meat, eggs, fish, etc., have the potential to augment income, increase employment, alleviate poverty and promote exports (Jha, 1996; Ramesh Chand, 1996; Vyas, 1996; Delgado and Siamwalla, 1999, Joshi et al 2007). However, the primary source of agriculture growth in Odisha for the period 2001-02 to 2013-14 was food-grains, followed by fruits and vegetables, and then livestock. Of the 6.3 per cent average growth in GVO of agriculture and allied activities for the period 2001-02 to 2013-14, 28.4 per cent was contributed by food grains, 24.9 per cent by fruits and vegetables, and 21.3 per cent by livestock (Table 9).

**Figure 9: Sector-wise shares in Total value of Output from Agriculture and Allied Activities (at Current prices)**



Source: Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

**Figure 10: Changing Composition of the Agriculture & Allied Sector (Percentage of Value of Output from Agriculture & Allied Activities)**



Source: Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

#### 4.1 Food-grain and Non-Food Crops

From Figure 9, it can be observed that in the early 1990s, food grains constituted the largest share in total value of output from agriculture and allied segment (39.6 per cent). However, in the 2000s, the share of food-grains declined to 27.5 per cent (TE 2013-14) while that of the fruits and vegetables and livestock segment increased to 45.9 per cent. This trend is similar to the national average; the share of food grains in the country as a whole declined from 32.2 per cent to 20.4 per cent while that of fruits and vegetables and livestock increased from 37.8 per cent to 41.1 per cent in the same period. However, the rate of shift is faster in Odisha than at the national level. Both cereals and pulses have shown a decline in share since the early 1990s (Figure 10). Figure 10 also shows that until 1991-92, the share of pulses in the total value of output from agriculture and allied activities was higher than that of livestock. However, after 1991-92, while livestock has shown an increasing trend, the share of pulses has fallen. Similarly, the non-food crop segment (oilseeds, fibre and sugar) has fallen from 10.8 per cent to 2.6 per cent in Odisha.

These trends are also visible from the production data presented in Table 10. As compared to the early 1990s, rice continues to be an important crop and its production has increased from 5.8 million tonnes in TE 1992-93 to 7.7 million tonnes in TE 2013-14. However, there has been a decline in pulse production while oilseeds production has remained stagnant. Further, Table 11 shows that while the productivity of rice in Odisha has improved over the last 20 years, it has not kept pace with the country wide improvement in productivity. Odisha's productivity is one of the lowest in the country, standing at 2.1 MT/ha in TE 2013-14 while the national average was 2.4 MT/ha (Table 11). States like Punjab, Tamil Nadu, Haryana and Andhra Pradesh recorded a productivity of above 3.0 MT/ha while its neighbour, West

Bengal, recorded a productivity of 2.7 MT/ha in TE 2013-14. What is worrisome is that the rice yield gap has remained almost stagnant in the last two decades. It is a matter of even greater concern that the gap between the yield rate in the state and the average yield rate for the country in both pulses and oilseeds has widened considerably over this period (Table 11 in Annexure I).

#### **4.2 Fruits and Vegetables**

As shown in Figure 9, the fruits, vegetables and floriculture segment constitutes a significant share of the total value of output from agriculture and allied activities in Odisha. Its share has marginally declined from 28.0 per cent in TE 1992-93 to 27.2 per cent in TE 2013-14. Vegetables constitute the largest share in this segment followed by fruits and floriculture. In TE 2013-14, Odisha was the seventh largest vegetable producer in the country (5.9 per cent of total vegetable production), after West Bengal (14.9 per cent), Uttar Pradesh (11.8 per cent), Bihar (9.8 per cent), Madhya Pradesh (7.4 per cent), and Andhra Pradesh and Gujarat (6.7 percent each). Around 8 per cent of the gross cropped area in Odisha is under vegetable cultivation as compared to the national average of 5.0 per cent. Within vegetables, brinjal, tomatoes, okra, cauliflower and cabbage are the main vegetables grown in Odisha.<sup>11</sup> Odisha is the second largest producer of brinjal and cabbage and the third largest producer of okra and tomatoes in the country. Vegetable production in Odisha increased by 16.2 per cent in TE 2013-14 as compared to TE 2007-08.

Vegetable productivity in the state has improved across the board but it remains one of the lowest in the country. In TE 2013-14, productivity was 13.8 metric tonnes per hectare, which is much lower than the national average (17.4 MT/ha) and its neighbouring states (West Bengal 17.7 MT/ha, Bihar 18.5 MT/ha, Andhra Pradesh 18.1 MT/ha and Madhya Pradesh 20.4 MT/ha). However, it is important to mention that comparing the productivity of vegetables as a whole can give a distorted picture because Odisha primarily grows low weight, high value vegetables like brinjal, cabbage, cauliflower, okra, tomatoes, etc., while states like West Bengal, Uttar Pradesh and Bihar are major producers of potatoes and Maharashtra, Madhya Pradesh, Karnataka and Gujarat are major producers of onions. Both these vegetables (onion and potatoes) are high weight, low value commodities. Looking at the data on individual vegetables in Table 13, we observe that the productivity of cabbage cultivation is above the national average, while that of brinjal, cauliflower, okra and tomatoes are below the national average. Further, while the yield gap has reduced for brinjal, it has increased for okra and tomatoes while it has remained stagnant for cauliflower.

Around 4 per cent of Odisha's GCA is under fruit cultivation, which is similar to the national average. The state ranks eleventh in fruit production, contributing around 2.6 per cent of the total fruit production in the country. The top fruit producers in TE 2013-14 were Andhra Pradesh (13.9 per cent), Maharashtra (13.7 per cent), Gujarat (9.7 per cent), Tamil Nadu (9.2 per cent) and Karnataka (8.0 per cent). Although low by national standards, the productivity

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<sup>11</sup> In TE 2013-14, 18.7 per cent of area under vegetables was under brinjal. 14.1 per cent under tomatoes, 9.7 per cent under okra, 6.5 per cent under cauliflower and 6 per cent under cabbage

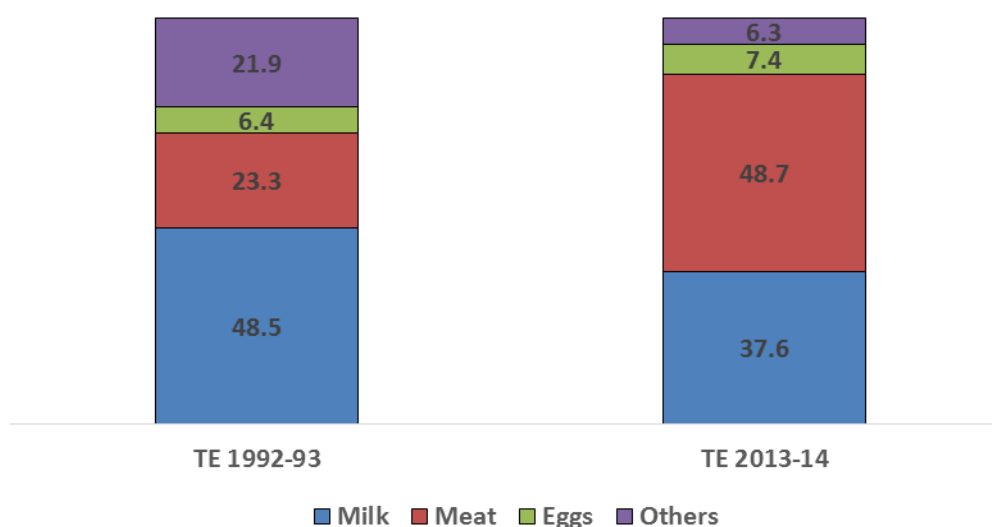
of all fruit crops has shown consistent improvement over the last few years. In fact, citrus productivity has overtaken the national average.

Within fruits, mango is the major fruit grown in Odisha, contributing the largest share in the total value of output from fruits and acreage. In TE 2013-14, mango cultivation accounted for around 60 percent of the area under fruits as compared to 24.3 per cent in TE 1992-93. In absolute figures, the area under mango has increased significantly from 53 thousand hectares (TE 1992-93) to 197.4 thousand hectares in TE 2013-14. Odisha is the ninth largest mango producing state, contributing round 4.2 per cent of the total mango production in the country (Table 14). However, productivity of mango cultivation is low in Odisha. From Table 14, it can be observed that mango productivity was 3.7 MT per hectare in TE 2013-14 as compared to the national average of 7.1 MT per hectare.

### 4.3 Livestock

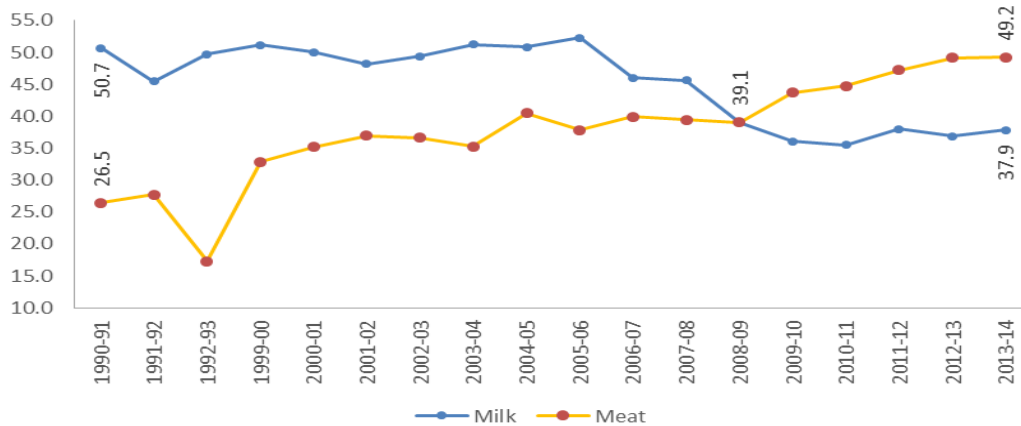
The livestock sector in Odisha has expanded robustly, with its share in the total value of output from agriculture and allied activities more than doubling from 8.2 per cent in TE 1992-93 to 18.7 per cent in TE 2013-14. Table 8 shows that the share of milk in the total value of output from agriculture and allied activities has increased from 4.0 per cent in TE 1992-93 to 7.0 per cent in TE 2013-14, while the share of meat has increased from 1.9 per cent to 9.1 per cent in the same period. Further, within the livestock sector, the composition has also changed from greater dominance of milk to meat. The share of milk in the total value of output from the livestock sector declined from 48.5 per cent in TE 1992-93 to 37.6 per cent in TE 2013-14, while that of meat increased from 23.3 per cent to 48.7 per cent in the same period (Figure 11).

**Figure 11: Composition of the Livestock Sector (Percentage of Value of Output from Livestock)**



Source: Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

**Figure 12: Changing Composition of the Livestock Sector (Percentage of Value of Output from Livestock)**



Source: Government of India, *State-wise Estimates of Value of Output from Agriculture and Allied Activities*

### 4.3.1 Meat Segment

The increase in the share of meat is partially because of an increase in the production of animal meat and an increase in poultry meat. In TE 2010-11, animal meat (sheep, goat and pig) contributed around 53.8 per cent of total meat production in Odisha and poultry around 46.2. Within animal meat, goat meat is the largest segment. However, the poultry segment is expanding rapidly in Odisha due to the vertical integration of the poultry value chain. Several private players such as Suguna and Pasupati Group are directly sourcing chicken from farmers in Odisha. Under this model, farmers are provided with day-old chicks, feed and health support. Once the birds reach are six weeks old, the birds are weighed and are sold under the respective brand name. Further, in southern and western Odisha, NGOs like Harsh Trust have contributed significantly towards poultry development. Harsh Trust has promoted three district level poultry co-operatives, a federation of these co-operatives called the Swarnajyoti Women’s Poultry Co-operative Federation Ltd (SWPCFL) and two agricultural co-operatives. These co-operatives are owned and managed by self-help group members. As a result of forming these collectives, communities in Odisha have strengthened their negotiating power with larger markets by eliminating middlemen. In 2014-15, due to the enhanced scale of work that the co-operatives achieved and increased operations from the regional to the national level, a producer company was registered in the name of Swarnajyoti Producer Company Ltd.

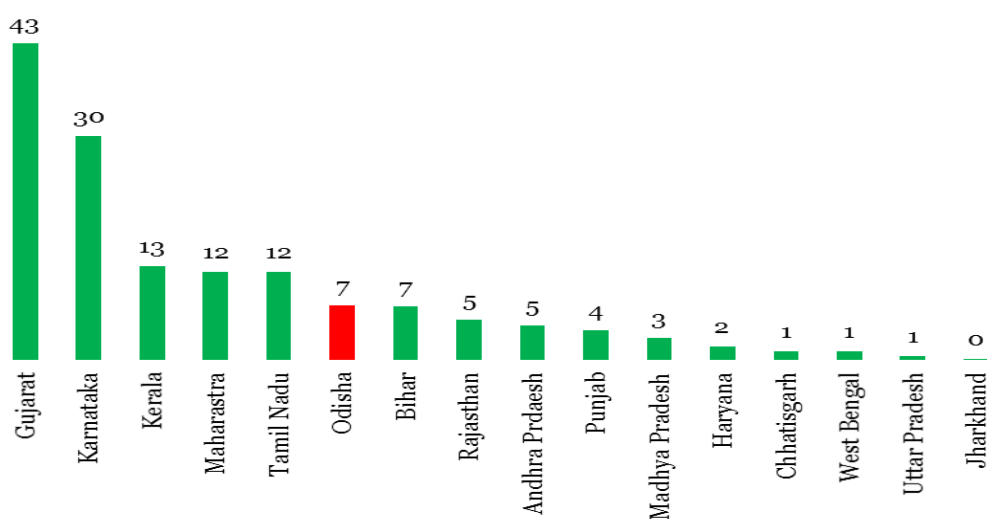
From Table 15 (in Annexure I), it is observed that livestock population in Odisha increased from 22.3 million in 1991 to 23.1 million in 2007, an increase of 3.6 per cent, while poultry population increased from 13.1 million to 20.6 million, a remarkable 57.3 per cent. Moreover, between 2008-09 and 2012-13, animal meat production increased from 65.4 thousand MT of animal meat (sheep, goat and pig) to 75.8 thousand MT, while poultry meat increased from 53.0 thousand MT to 65.0 thousand MT in the same period. Thus, during this period, growth of poultry meat at 23 per cent has been faster than of animal meat production, which was only 16 per cent.

### 4.3.2 Milk Segment

The share of milk in the total value of output from agriculture and allied activities has almost doubled from 4.0 per cent in TE 1992-93 to 7.0 per cent in TE 2013-14 (Table 8). Milk production in Odisha increased from 0.9 million tonnes in 2001-02 to 1.9 million tonnes in 2013-14, a CAGR of 5.5 percent. Around 85 per cent of total milk produced is contributed by cow milk in the state. In milk production, Odisha is the third fastest growing state after Bihar (CAGR 7.9 percent) and Andhra Pradesh (CAGR 6.3 percent). Despite this fast growth, Odisha is ranked 14<sup>th</sup> in milk production, contributing only 1.3 per cent of total production in TE 2013-14 as compared to 17.6 per cent for Uttar Pradesh, 9.5 per cent for Andhra Pradesh, 7.8 per cent for Gujarat, 7.4 per cent for Punjab and 5.2 per cent for Bihar (Table 18 in Annexure I). As per the 2007 Livestock Census, Odisha had 3.2 per cent of the total milch animals in India, which is higher than the numbers of milch animals in Punjab, Haryana or Kerala; yet, these states have higher milk production due to higher productivity as compared to Odisha. 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, Uttar Pradesh's 1.0 MT per female animal. Moreover, only 15.1 per cent of the total milk produced in Odisha is procured by organised players such as co-operatives and private companies while in Gujarat, 43 per cent of total production is procured by co-operatives alone (Figure 13).

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. 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 the market is not expanding to enable the off-take of higher 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.

**Figure 13: Milk Procured by Co-operatives (% of Production)- 2013-14**



Source: Calculated from NDDB data

#### **4.4 Fisheries**

Fisheries contributes around 6.4 per cent of the total value of output from agriculture and allied activities (TE 2013-14). The strength of the fisheries sector in Odisha lies in the large un-utilised freshwater and brackish water resources. Odisha's 480-km long coastline has huge potential for marine fishery development, while an area of around 1 million hectares under tanks, ponds, swamps, lakes, reservoirs, rivers and canals, 32,587 hectares of cultivable brackish area, 3 lakh hectares of estuaries, brackish water and backwater areas and 93,000 hectares of the Chilika lake have potential for the development of freshwater fisheries (Perspective Plan 2010 to 2020 for Fishery Development, Odisha). Currently, Odisha is the eighth largest fish producer in the country (4.4 per cent of all India production), after Andhra Pradesh (19.9 per cent), West Bengal (16.7 per cent), Gujarat (8.7 per cent), Kerala (7.6 per cent), Tamil Nadu (6.8 per cent), Maharashtra (6.5 per cent) and Uttar Pradesh (4.9 per cent) (Table 19). Fish production in Odisha has recorded a CAGR of 3.4 per cent in the period 2000-01 to 2013-14. Apart from 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. The government needs to exploit such potential in order to diversify agricultural production and reduce the risk of natural calamities.

### **5. Drivers of Agriculture Growth**

In this section, first we examine the potential drivers of agriculture growth in Odisha using a simple OLS regression model and later use the Engle-Granger Test for co-integration to test for the long-term relationship between the selected variables.

#### **5.1 Econometric Analysis**

Agriculture 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 agriculture growth. However, it is difficult to analyse the effects of all the variables in a single framework, because many of these variables can be correlated and because of paucity of data. Therefore, we use a parsimonious model to analyse the potential drivers of growth. Table 20 gives the correlation matrix of the variables. It is observed that GDPA shows a significant and positive correlation with irrigation, certified seeds and fertiliser consumption, diversification towards fruits and vegetables and total road density.

##### **5.1.1 Estimating the Equation**

In our model, log of GDPA is the dependent variable and the variables mentioned above are our independent variables. We have used data from 2000-01 to 2012-13 and run the model with different variables (south-west monsoon, agriculture credit, fertiliser consumption, terms

of trade, etc.) but have presented only those variables that have a significant effect on agricultural GDP. We have estimated the following static model.

$$Y_t = \beta_0 + \beta_1 X_{t1} + \beta_2 X_{t2} + \beta_3 X_{t3} + u_t \quad (1)$$

where,  $X_{t1}$  is road density;  $X_{t2}$  is irrigation ratio; and  $X_{t3}$  is the share of fruits, vegetables and floriculture in total value of output from agriculture and allied activities. In Table 21 (in Annexure I), we present the results.

$$Y_t = 5.9^{***} + 0.89^{***} X_{t1} + 0.48^{***} X_{t2} + 0.3^{**} X_{t3} + u_t$$

From Table 21, it can be seen that, irrigation, diversification and road density have a significant and positive effect on agricultural GDP. The four independent variables together explain around 96 per cent 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, one per cent growth in the irrigation ratio increases agricultural growth by 0.48 per cent. Currently, Odisha has low irrigation coverage as compared to the national average. There is huge potential for Odisha to increase ground water irrigation. However, as seen in the next section, this is only possible when the quantity and quality of power supply which is currently at an abysmal level, for agriculture is improved.

Similarly, Table 21 shows that, all else being equal, one per cent increase in the share of fruits, vegetables and floriculture in the total value of output from agriculture and livestock will increase agricultural growth by 0.13 per cent. We have seen in the previous section that Odisha's agricultural portfolio is gradually moving towards horticulture; however, in terms of acreage, around 74 per cent of gross cropped area falls under food-grains and only 13.7 per cent of GCA is under fruits and vegetables. Food grains are low value crops while fruits and vegetables are high value crops; increasing the area under fruits and vegetables has the potential to increase agriculture growth and incomes of small farmers in Odisha.

Finally, we find that, all else being equal, a one per cent increase in road density increases agricultural GDP by 0.89 per cent. Roads play a very important role in overall agricultural development. It is the only means through which farmers are connected to both the output and input markets. However, it is not enough to just increase road density. The government needs to increase surface road density, which is very low in Odisha (details discussed in the next section).

### **5.1.2 Stationarity and Co-integration**

It is important to note that time series data have a common tendency of growing over time. If we ignore this tendency of two or more sequences trending in the same or opposite direction, we can erroneously conclude that changes in one variable are actually caused by changes in another variable. In many cases, two time series processes appear to be correlated only because they are both trending over time for reasons related to other unobserved factors (Wooldridge, 2009). In other words, we need to account for unobserved, trending factors that affect the dependent variable being correlated with the explanatory variables. If we ignore

this possibility, we may find a spurious relationship between our dependent and explanatory variables. According to Granger and Newbold,  $R^2 > d$  where  $d$  is the Durbin-Watson statistics, is a good rule of thumb for suspecting that the estimated regression is spurious. From Table 21, we find that  $R^2 < d$ ; therefore, based on this rule of thumb and economic theory, we can conclude that the estimated regression is not spurious.

We also check for the stationarity of our time series variables by using the Augmented Dickey Fuller test and Kwiatkowski-Phillips-Schmidt-Shin test (KPSS). In Table 22 (in Annexure I) we have presented the results of the Augmented Dickey Fuller test (ADF). We find that the gross domestic product from agriculture (GDPA), irrigation ratio and road density<sup>12</sup> are integrated of order 1, i.e., they are stationary in the first difference form,  $I(1)$ . However, we reject the null hypothesis of unit root for the variable ‘diversification’. The KPSS test (Table 23) with its natural null of stationarity contradicts the results of ADF. Based on the results of the unit root tests, the four series are taken to be integrated of order 1 but their differenced values are  $I(0)$ . It is possible that these series contain a common stochastic trend and need not be spurious. In this case, despite the trend, they will move together over time such that they will be co-integrated. Economically speaking, the four series will be co-integrated if they have a long-term, or equilibrium relationship between them.

### ***5.1.3 Engle-Granger Test for Co-integration***

To test for co-integration between the four non-stationary time series, we simply run the OLS regression in equation (1), and then run the ADF test on the residual to determine if it is stationary. This method is similar to the Engel and Granger (1986) two-step residual test. The time series are said to be co-integrated if the residual is itself stationary. In effect, the non-stationary  $I(1)$  series have cancelled each other out to produce a stationary  $I(0)$  residual. Table 24 presents the Augmented Dickey Fuller Test for the residuals. We reject the null hypothesis of non-stationarity at the 1 per cent level of significance. Given that we have established that there is co-integration between GDPA, irrigation ratio, road density and diversification, the OLS results presented in Table 24 are perfectly meaningful and not spurious, even though we are using levels of non-stationary data. Further, there is a long run relationship between GDPA, irrigation ratio, road density and diversification in Odisha.

## ***5.2 Status of Physical Infrastructure in Odisha***

Physical infrastructure such as irrigation, power and roads play an important role in stimulating agricultural investment and growth (FAO, 1996). Further, several studies (Antle, 1984; Binswanger et al, 1993; Fan, Gulati and Thorat, 2007; Fan and Zhang 2004) have shown that investment in rural infrastructure has the potential to increase farmer’s access to the 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 Odisha to understand the reasons for low productivity and growth in the agriculture sector.

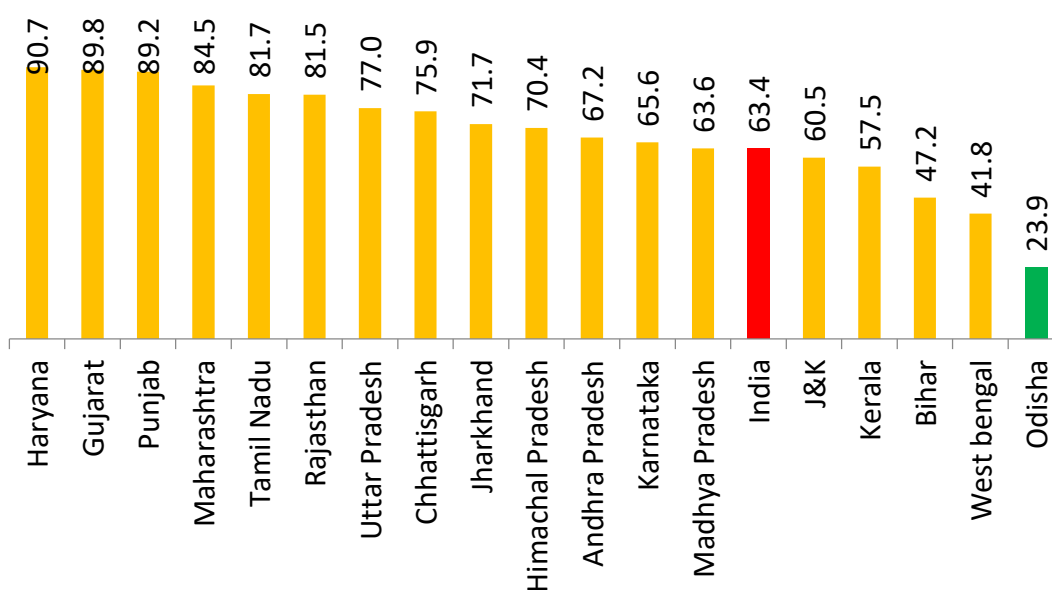
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<sup>12</sup> All variables in log form

### 5.2.1 Roads

Roads play a very important role in the development of rural areas as it reduces transportation cost, increases competition, reduces marketing margins and connects the input and output markets, thus improving farm incomes. From Table 30, it can be seen that Odisha's road density is much higher than the national average; however, surfaced road density is substantially lower than the national average. As a matter of fact, it is one of the lowest in the country. In 2011-12, only 23.9 per cent of total road length was surfaced in Odisha, while Gujarat and Punjab had around 89 per cent of their roads surfaced. Uttar Pradesh, Madhya Pradesh and Bihar had 77 per cent, 61.5 per cent and 47.2 per cent of the total road length surfaced (Figure 14). Further, 46 per cent of villages in Odisha do not have all-weather connectivity. About 62 per cent of rural roads are blacktopped and only 8.4 per cent are concrete roads (Economic Survey of Odisha, 2014-15). Odisha, being subject to frequent floods, needs to improve the coverage of concrete roads which is more durable than black topped roads in regions where the water table is high.

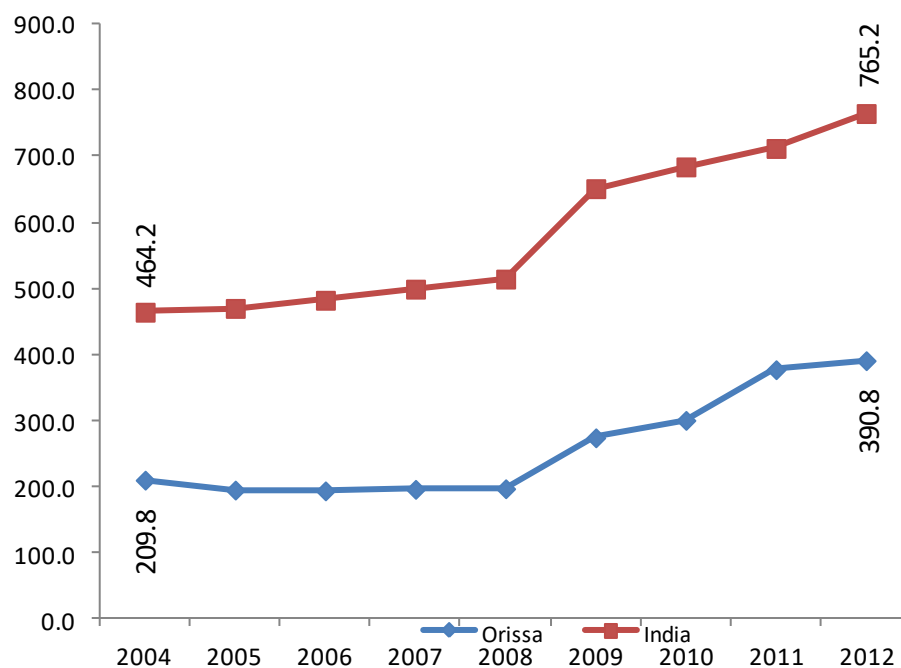
**Figure 14: Surfaced Roads-2011-12 (% of Total road length)**



\*\*Note As per discussion with Ministry of Roads, Transports & Highway, the Government of Odisha has reported 1,71,070 km road length as on March 31, 2011 to the Ministry of Road Transport & Highways under zilla parishad and panchayat samiti roads, without providing the category wise details, i.e., surfaced and un-surfaced road length. As the information was received late, the data was not incorporated in the Basic Road Statistics of India 2010-11. Since the government did not provide data on panchayati raj roads in the subsequent years, the figure 1,71,070 km was repeated in the Basic Statistics of India 2011-12, 2012-13, 2013-14 and 2014-15. In the absence of the surfaced and un-surfaced break-up, it got inadvertently incorporated in the surfaced category of roads in the 2012-13, 2013-14 and 2014-15 issues of Basic Road Statistics of India. Therefore, we have limited our analysis to 2011-12 (Annexure-III).

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

**Figure 15: Surface Road Density (per '000 sq km)**



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

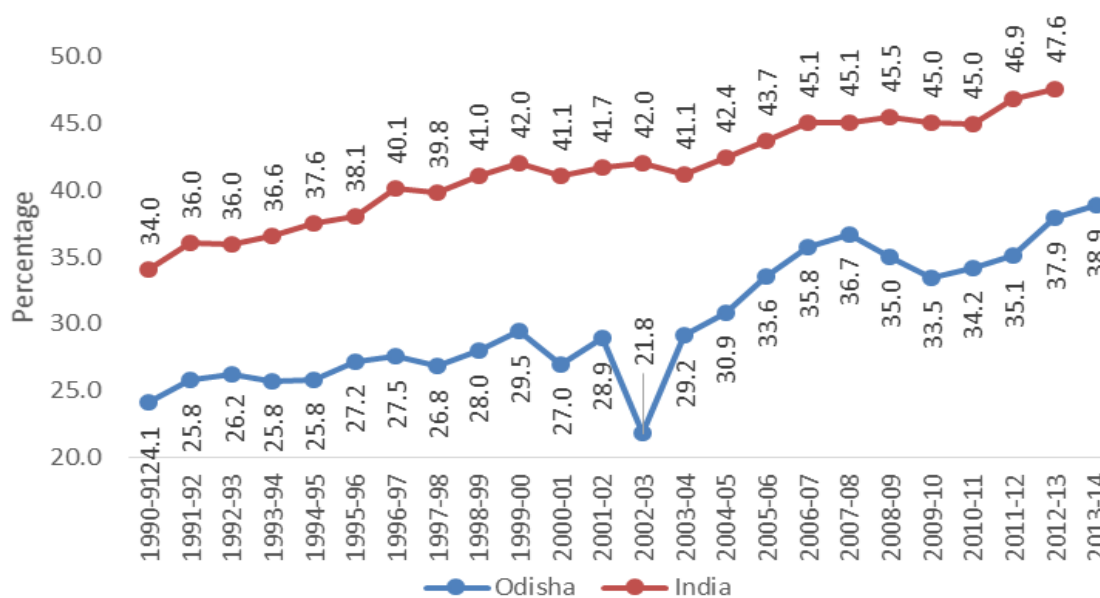
### 5.2.2 Irrigation

Irrigation being an important determinant of agricultural growth in the state, we first look at the availability and utilisation of water resources. Odisha receives a copious amount of rainfall. The normal annual rainfall in Odisha is 115 cm, of which the south-west monsoon contributes about 80 per cent in the months from June to September. Although the quantum of rainfall is quite high, its distribution during the monsoon period is highly uneven and erratic (Directorate of Agriculture, Odisha). There is also spatial variation in rainfall across the state: the southern coastal plains receive about 120 cm while the northern plateau gets about 170 cm. The vulnerability of agriculture is increased by the fact that the state as a whole frequently experiences droughts, when rainfall is deficient by more than 20 per cent. The uncertainties surrounding rainfall and the dominance of red soil makes agriculture substantially dependent on irrigation in the state. However, Odisha's irrigation ratio (gross irrigated area as a proportion of gross cropped area) is relatively low compared to the all-India average. Figure 16 shows the position of Odisha as compared to the national average for the period 1990-91 to 2013-14. At the outset, the irrigation ratio in Odisha was 24.1 per cent, a good 10 percentage points behind the all-India average. By 2012-13, the ratio had moved up but only to 37.5 per cent, so that the gap with the all-India average remained at 10 per cent.

In the meantime, as shown in Table 25 (in Annexure I) many states, particularly the comparator states, have made impressive progress. In Punjab, the irrigation ratio was already more than 94 per cent and there was very little room for further improvement. However, the

ratio improved from 60.4 in 1990-91 to 77.2 in Uttar Pradesh, from 41.4 to 65.9 in Bihar, from 19.9 to 36.3 in Madhya Pradesh and 28.1 to 47.0 in Gujarat. Every comparator state has performed better than Odisha in improving the irrigation ratio.

**Figure 16: Gross irrigated Area as a percentage of Gross Cropped Area**

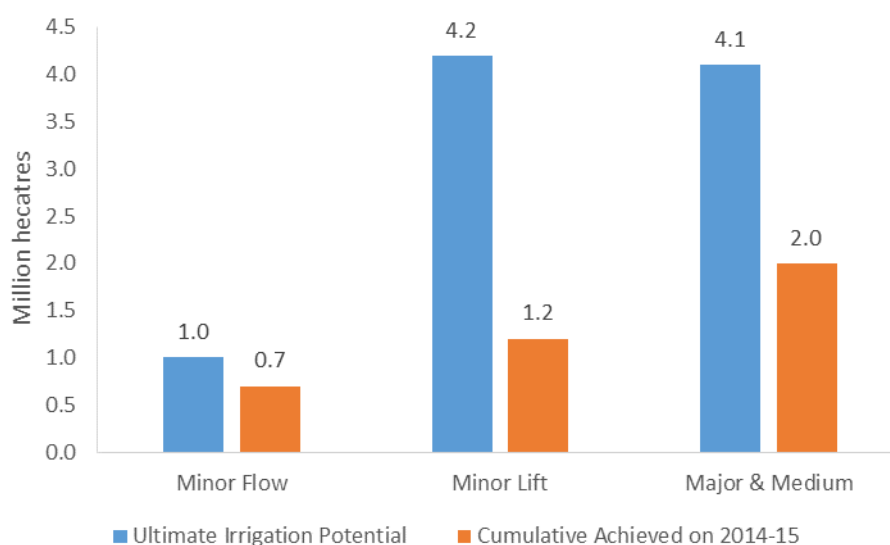


## All India irrigation ratio available until 2012-13

Source: Directorate of Economics & Statistics

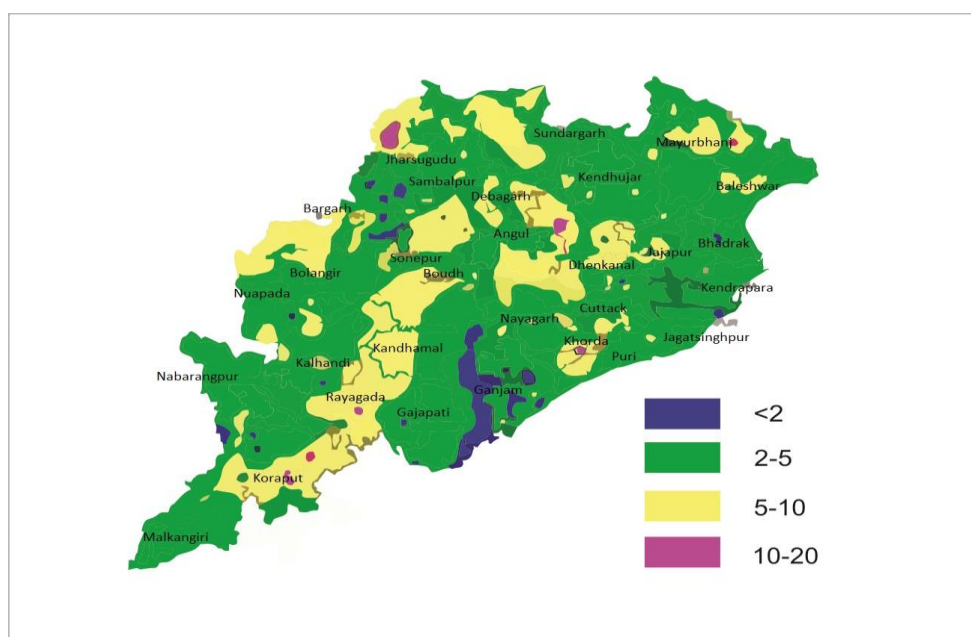
Odisha's poor progress in improving the irrigation ratio could be because of under utilisation of exploitable water resources. As per the Central Water Commission, Odisha has an ultimate irrigation potential (UIP) of 8.8 million hectares, out of which 3.6 million hectares can be irrigated through major and medium projects and 1 million hectares through minor flow and 4.2 through minor-lift irrigation. However, as of 2014-15, Odisha managed to exploit only 48.8 per cent of major and medium irrigation potential (IPC), 70 per cent of minor-flow and 28.6 per cent of minor lift irrigation. On completion of ongoing major and medium irrigation projects, Odisha will add another 0.4 million hectares, improving the IPC to UIP ratio to around 58.5 per cent in the coming years. However, Odisha lags behind in lift irrigation in which the IPC/UIP ratio was only 28.6 per cent in 2014-15 (Figure 17). Although rich in groundwater resources, Odisha has underutilised these resources. Only 26 per cent of the total 11.9 BCM of ground water available for irrigation is being utilised. In comparison, Madhya Pradesh's expansion of irrigation is attributed to issuing large-scale, temporary tube-well power connections for up to 110 days to meet the irrigation requirements for wheat, which is the state's main winter crop. As a result, Madhya Pradesh has utilised 56 per cent of the total 13.8 BCM ground water available for irrigation.

**Figure 17: Untapped Irrigation Potential in Odisha**



Source: Department of Water Resources, Odisha and Water Related Statistics, 2015

**Figure 18: Depth to Water Level (metres below ground level) (January 2016)**



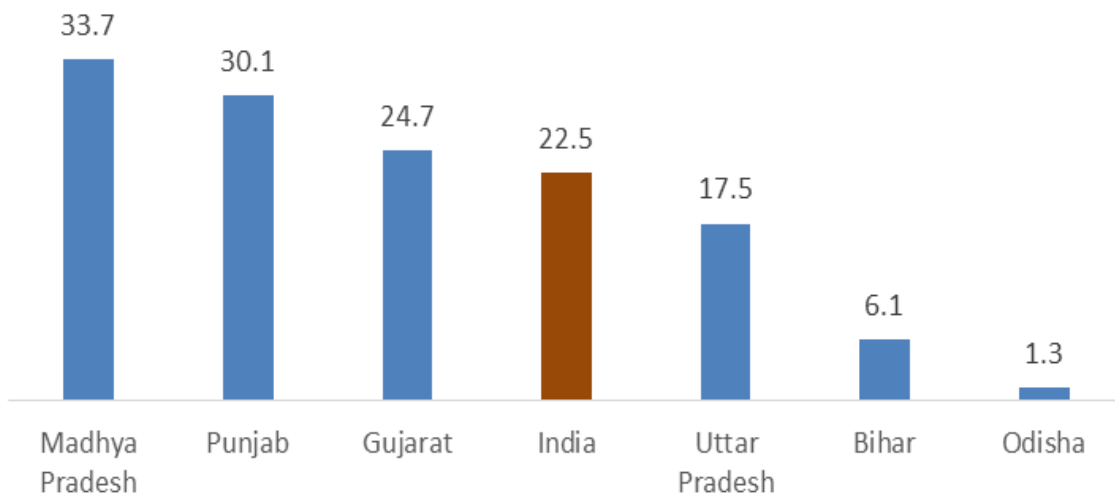
Source: Central Ground-water Board

Expansion of irrigation in Odisha needs comprehensive action for the completion of ongoing major and medium projects, restoration of distribution systems where they are in disrepair, rejuvenation of tanks and other minor irrigation (flow) projects. But what is needed above all is a sizable increase in the utilisation of existing ground water resources.

### 5.2.3 Energy for Agriculture

One of the main reasons for this underutilisation of ground water resources in Odisha is the poor state of power supply. The share of agriculture in the total sale of power is abysmally low in Odisha. Only 1.3 per cent of total sales went to agriculture in 2012-13 as compared to the national average of 22.5 per cent. In Madhya Pradesh, Punjab and Gujarat, the ratio of use of power in agriculture to total sale of power was around 33.7 per cent, 30.1 per cent and 24.7 per cent respectively (Figure 19).

**Figure 19: Share of agriculture in total power sales (2012-13)**



## Note: Odisha data for power available till 2011-12

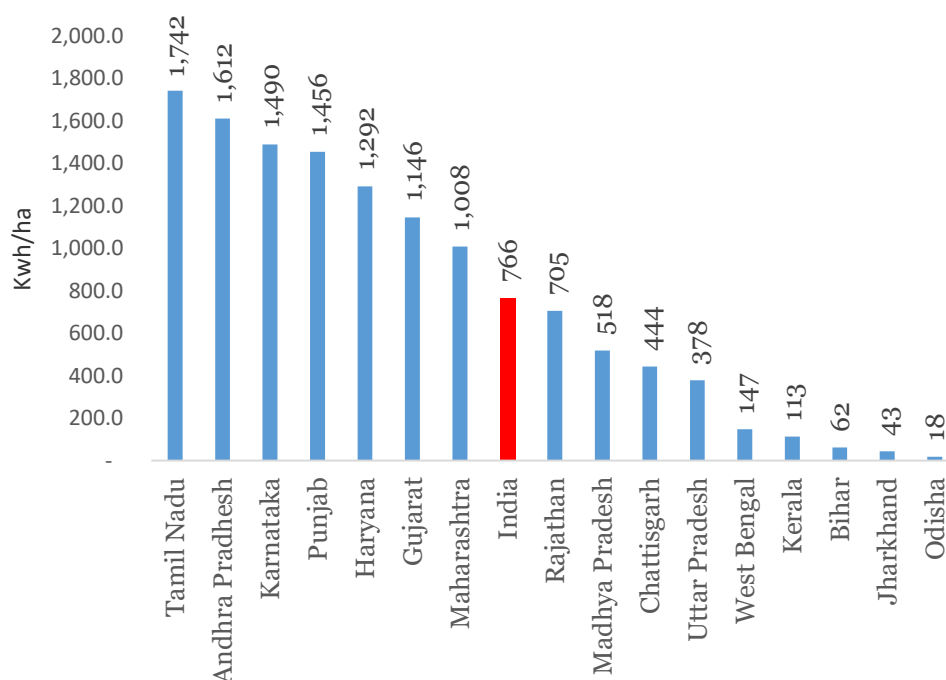
Source: Annual report (2013-14) on the Working of State Power Utilities & Electricity Departments, Planning and Energy Division of Planning Commission

Further, state-wise data on power intensity, i.e., the ratio of electricity used per hectare, confirms the extremely low use of electricity by the agricultural sector in Odisha. Tamil Nadu, Andhra Pradesh, Karnataka, Punjab, Haryana, Gujarat and Maharashtra use over 1,000 Kwh/ha, while Odisha recorded an abysmally low amount of 18 Kwh/ha (Figure 20). This is despite Odisha being a pioneer in power sector reforms; in 1995, Odisha unbundled generation, transmission and distribution. The power supply situation in the state epitomises the inefficiencies of the power supply situation in the country as a whole. Theft of electricity is rampant due to weakness in governance and is reflected in the aggregate technical and commercial (AT&C) loss in the state, which stood at 41.9 per cent against the national average of 26.2 per cent. Despite being a net producer of power, with generation being much more than domestic demand and sale of electricity to other states, Odisha suffers from poor quality of power because of voltage fluctuations and frequent power outages. Further, during the peak demand period, there is a deficit in supply. The Economic Survey of Odisha for 2014-15 states that during 2013-14, the peak demand was 3,300 MW while the amount met

was 2,600 MW. This gives a peak deficit of 21.2 per cent against the all- India peak period deficit of 9.8 per cent. This peak deficit translates into inefficiencies in supply.

Supply of power for agriculture in the state also suffers from a major deficiency, which is common to all states in greater or smaller measure, viz., weaknesses in the transmission and distribution infrastructure resulting in lack of uninterrupted supply of good quality power to agricultural consumers. To remedy the situation, in 2014, the Government of India launched the Deen Dayal Upadhya Gram Jyoti Yojana (DDUGJY) under which funds are being made available to state governments to take up works for the strengthening the distribution system and the separation of feeders for agricultural and non-agricultural consumers. Under DDUGJY, a sum of Rs.1657 crore has been sanctioned for Odisha so far, out of which Rs.727 crore is for system strengthening and Rs.141 crore is for the segregation of feeders. Power officials maintain that the main problem is the lack of demand for power from agricultural consumers. However, the authors believe that non-availability of good quality and quantity of power is the real source of the problem, and once this deficiency is remedied, farmers will use more power for lift irrigation.

**Figure 20: Power Intensity (Power Sales/GCA (KWh/ha) TE 2012-13**



Source: Calculated from Planning Commission, Planning and Energy Division and DES

Odisha has made progress in implementing the country wide rural electrification programme having electrified 93.4 per cent of villages against the all-India tally of 95.7 per cent of villages as of March, 2014. However, because of inefficiencies in the quantity and quality of supply, the availability of power for agriculture lags behind the rest of the country. In order to improve ground water irrigation, a big improvement is needed in rural power supply in the state. An alternative to the dependency of farmers on poor quality electricity is to tap the

potential of solar power. Solar irrigation pumps can be installed in regions where the grid is absent or there is no supply of power. These pumps can replace electric and diesel pump sets. If electric pump sets are replaced by solar pump-sets, it can help reduce the annual power subsidy bill of the government to the agricultural sector. This could then also be used for financing up front capital costs for solar installations. Moreover, replacing diesel pump-sets can save farmers from high priced and polluting diesel as well as well as save on the government subsidy on diesel (Gulati, Manchanda and Kacker, 2016). However, when ground water is utilised using solar pump sets, it should be ensured that ground water extraction is not more than recharge capacity. In order to incentivise farmers to ensure that there is no overdrawal of ground water, farmers should be given the option of selling surplus power to the grid. A solar irrigation co-operative named Dhundi Saur Urja Utapadak Shahakari Mandli (DSUUM) in Gujarat is already selling surplus solar power to the state discom by connecting solar pumps to the grid.

Moreover, in regions where fallow land is increasing due to lack of irrigation, solar energy can be utilised to provide assured irrigation. As discussed earlier, during the rabi season, large tracts of land are usually left fallow in Odisha. Irrigation through solar energy can enable utilisation of land that is currently left fallow to grow pulses and oilseeds, which have shown a declining trend in recent years. The recent increase in the minimum support prices (MSP) of pulses and the government's commitment towards increased procurement of pulses can benefit the farmers of Odisha if the state government is able to take advantage of existing potential.

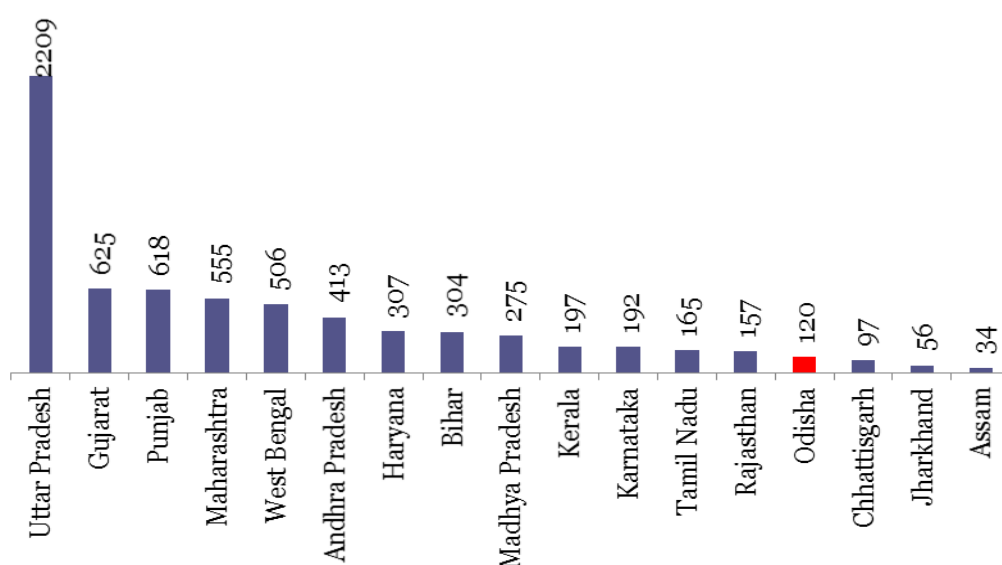
Considering the potential for the use of solar pumping for agriculture over the country, the Government of India came out in 2014 with the solar pumping programme for irrigation and drinking water, under which the Ministry of New and Renewable Energy (MNRE) provides financial assistance up to 30 per cent of the project cost. The initial sanction was for the installation of 100000 solar photovoltaic water pumping systems in the country. Commercial banks will also lend a hand through loans up to 50 per cent of the cost and NABARD will provide refinance. In view of the fact that irrigation needs are intermittent, between 200 and 250 days in a year, the guidelines issued by the MNRE indicate that the government expects that farmers will be encouraged to connect solar pumps to feed surplus power back to the grid. Besides, it is expected that micro- solar pumps with less than 75 Wp to 500 Wp with 0.1 HP to 0.5 HP pump of power can replace swing buckets, hand pumps or treadle pumps for farmers who grow vegetables on very small plots of land. Despite the promise of solar pumps and the financial assistance provided by the central government, the scheme has not attracted much response from farmers in the state so far.

#### ***5.2.4 Infrastructure for Food Processing***

As discussed in the previous section, Odisha is undergoing a gradual transformation away from food grains towards high value commodities such as milk, meat and fruits and vegetables. A major issue with high value food-items is its perishable nature. The short shelf life of these commodities makes it a risky activity due to high post-harvest losses. In order to minimise post-harvest losses, cold storages play an important role. Until 2015, Odisha had

only 120 cold storages with a total capacity of 3.7 lakh MT. In comparison, Bihar had 304 cold storages with a total capacity of 14.1 lakh MT. The cold storages in Odisha are mainly used for potatoes. Lack of assured power supply in rural areas poses a critical bottleneck to the development of cold storage infrastructure. Here too, solar energy can play an important role. Installation of solar panels on the roof of storage units/warehouses in locations where grid lines are absent or are unreliable can provide a solution. The Central Institute for Agricultural Engineering (CIAE), Bhopal, developed a 5X4.4X3 m and 20 kwp plant with power storage at a cost of Rs 20 lakh spread over 15 years. It was found that, for mangoes, it helped increase product shelf life, reduce weight loss and improve quality (Gulati, Manchanda and Kacker, 2016).

**Figure 21: Number of Cold Storages (2015)**



Source: Lok Sabha and Rajya Sabha Questions

## 6. Plan Schemes and Budget Outlays

The Odisha Department of Agriculture has the mandate to plan, develop, utilise and manage the state's resources efficiently and effectively to enhance farm income and ensure food security (Government of Odisha, Outcome Budget, 2016-17). In order to achieve this, the Government of Odisha has decided on the following interventions:

- Increase irrigation potential by enhancing captive irrigation facilities and exploitation of ground water potential through the establishment of shallow tube-wells (STWs), manually operated tube-wells (MTWs), dug wells, deep bore wells and river lifts.
- Create soil testing facilities for more than 3.75 lakh samples per annum and maintain soil health.

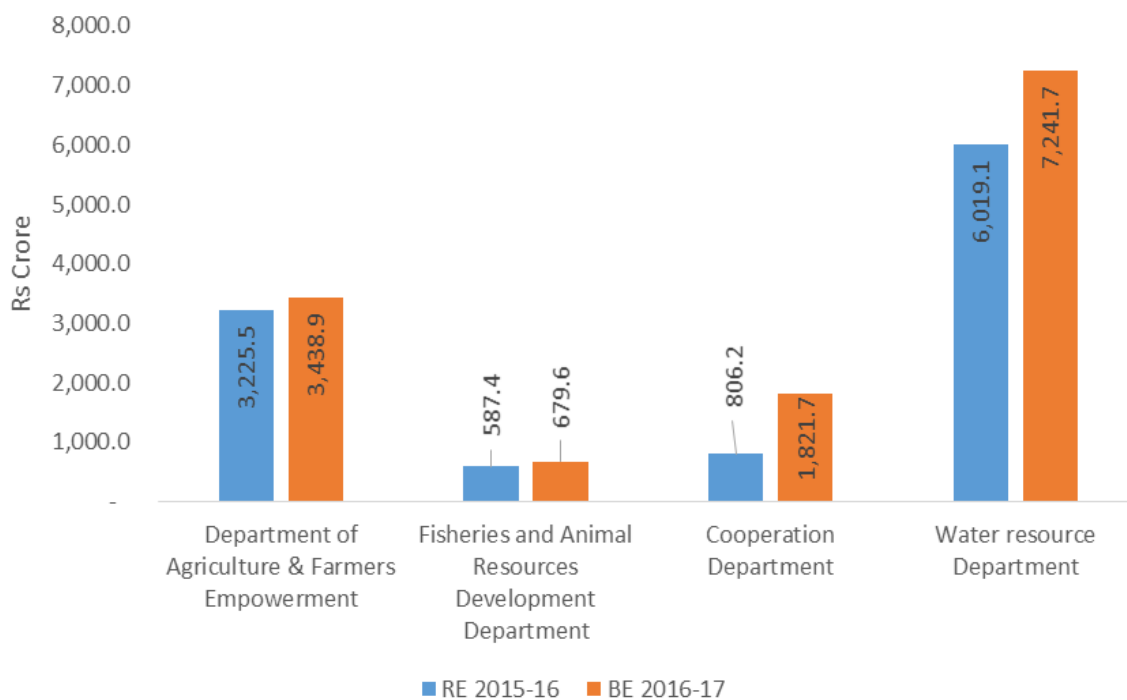
- Promote the system rice intensification (SRI)<sup>13</sup> method of paddy cultivation
- Encourage horticultural crops and introduce special crop specific schemes for banana, floriculture, coconut and betel vine (see Annexure II)
- Introduce large scale vegetable cultivation in peri-urban areas and encourage off-season vegetable cultivation to increase farm income
- Implement the state agriculture policy 2013 (see Annexure II)
- Increase the seed replacement rate (SRR) through the production of quality seeds under the seed village scheme and in departmental farms. The private sector will also be encouraged to promote more seed production in the state
- Popularise farm mechanisation to reduce the cost of production and improve productivity
- Promote organic farming, especially in districts where fertiliser consumption is low
- Introduce a programme for management of acid soil by the use of paper mill sludge, press mud of sugar mills, lime etc
- Diversify from paddy to more remunerative non-paddy crops, viz., pulses, oilseeds, maize, sugarcane, cotton, vegetables and other horticultural crops
- Increase water use efficiency through large scale popularisation of micro-irrigation systems through the National Mission on Sustainable Agriculture (NMSA)
- Increase production and productivity of various crops like rice, pulses, oilseeds, coarse cereals and commercial crops by implementing various centrally sponsored schemes such as National Food Security Mission (NFSM) (rice), NFSM (pulses), NFSM (coarse cereals), NFSM (commercial crops), National Mission on Oilseeds and Oil Palm (NMOOP), etc. (Annexure II).
- Implement the National Horticulture Mission programme in the state for the development of horticultural crops
- Implement watershed development under the Integrated Watershed management Programme (IWMP)
- Emphasise the development of agriculture and allied sectors through the Rashtriya Krishi Vikas Yojna (RKVY) scheme.

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<sup>13</sup> SRI is an agro-ecological technology to increase productivity of irrigated rice by changing the management of plants, soil, water and nutrients. SRI can increase yield by around 20-100%, reduce seed requirement up to 90% and save water by up to 50%. (<http://sri.ciifad.cornell.edu/>)

In 2016-17, the Odisha government allocated Rs. 94,052 crore for all state government departments, out of which around 3.7 per cent was allocated to the Department of Agriculture & Farmers Empowerment (Rs 3,438.9 crore), 7.7 per cent for the Water Resource Department (Rs 7,241.7 crore), 1.9 per cent for the Co-operation Department (Rs 1,821.7 crore) and 0.7 per cent for the Fisheries and Animal Resource Development Department (Rs 679.6 crore).

**Figure 22: Budget allocations by Departments (Rs Crore)**

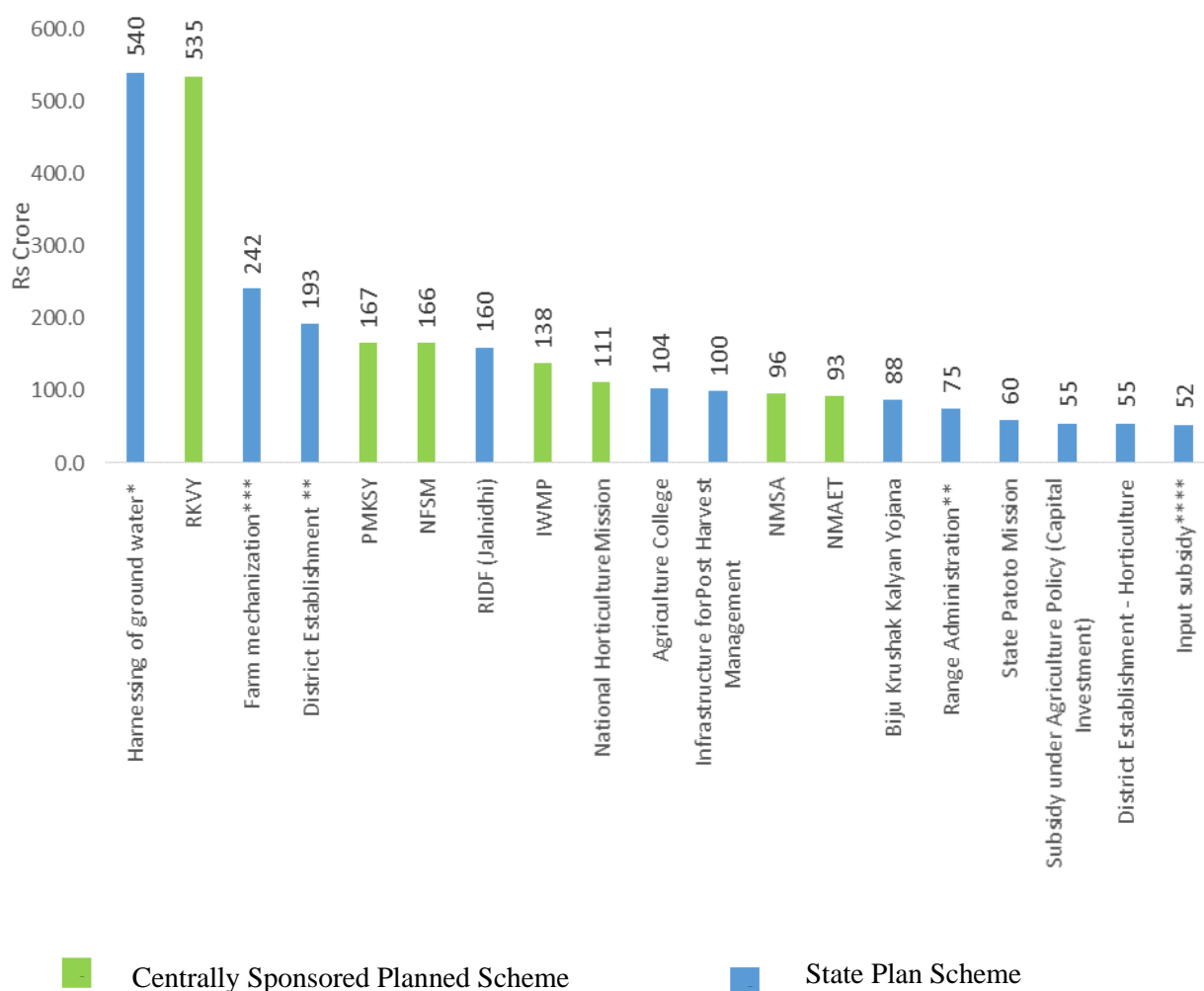


Source: Odisha Budget 2015-16 and 2016-17

Of the Rs.3,438.9 crore allocated to the Department of Agriculture and Farmers Empowerment in 2016-17, around 15.7 per cent (Rs.540 crore) was allocated to the ‘sustainable harnessing of ground water in water deficit area’ scheme. This state scheme was introduced in 26 districts of Odisha in 2010-11. Under the scheme, deep bore wells are being constructed in clusters in farmers’ fields and farmers get a subsidy of 90 per cent of the project cost.

Next, around 15.5 per cent (Rs.535 crore) of the funds allocated to the Department of Agriculture and Farmers Empowerment went to the centrally sponsored RKVY scheme. This scheme was introduced by the Government of India in 2007-08 in order to provide incentives to the state to increase expenditure on agriculture and allied sectors to sustain a growth rate of 4 per cent. The scheme promotes development of agriculture, horticulture and other allied sectors like animal husbandry, dairy development, fisheries, agricultural research and education, minor/lift irrigation, command area development, watershed development, etc.

**Figure 23: Allocation of Rs.50 crore and above for various schemes – 2016-17**



Source: Odisha Budget 2016-17

Note: \* in water deficit areas; \*\* for agriculture; \*\*\*Popularisation of agricultural implements, equipment and diesel pump sets; \*\*\*\* Input subsidy on seeds, fertilisers, bio-fertilisers, insecticides, bio-pesticides etc. (Agriculture)

The state allocated Rs.242 crore to a scheme to popularise agricultural implements, equipment and diesel pump sets. This state-funded scheme aims to reduce the drudgery in agricultural operations with increased farm mechanisation. Subsidies are given to popularise the use of tractors, power tillers, reapers, transplanners, rotavators, power-operated implements, manually operated bullock drawn implements, pump sets, combine harvesters and power threshers. .

The fifth largest component was to set up a district establishment for agriculture (excluding horticulture). Around Rs.193 crore was allocated to meet the running charges of wages of casual labour for watch and ward along with the rent of an additional sale centre in each block.

Further around Rs.167 crore was allocated to the centrally sponsored Pradhan Mantri Krishi Sinchi Yojana (PMKSY) and Rs.166 for the National Food Security Mission (NFSM). The major objectives of the PMKSY scheme is to ensure convergence of investments in irrigation at the field level, expand cultivable area under assured irrigation, improve on-farm water use efficiency to reduce wastage of water, enhance the adoption of precision irrigation and other water saving technologies, enhance recharge of aquifers and introduce sustainable water conservation practices by exploring the feasibility of reusing treated municipal waste water for peri-urban agriculture and attract greater private investment in precision irrigation systems. The NFSM scheme was launched in 2007-08 by the centre to increase the production of rice and pulses through area expansion and enhancement of productivity in identified districts (see Annexure II).

To provide assured irrigation, the state government has also allocated around Rs.160 crore to the Jalnidhi scheme. The state government has been taking soft loans from NABARD under the Rural Infrastructure Development Fund (RIDF) to provide subsidy to farmers to dig shallow tube-wells/deep bore wells/constructing dug wells on their field, besides taking resources to river lift/surface lift wherever possible.

Further, Rs.138 crore was allocated to the centrally sponsored Integrated Water Management Programme (IWMP). This programme was launched in the state during the year 2009-10 with a funding pattern of 90:10 between the centre and state government. IWMP is being implemented to prevent soil run-off, regenerate natural vegetation, encourage rain water harvesting and recharge the ground water table in the state. The programme is in operation in 26 districts of the state.

In addition, Rs.111 crore was allocated to the centrally sponsored National Horticulture Mission. The National Horticulture Mission (NHM) has been in operation in the state since 2005-06 in 24 districts. The scheme was implemented with 100 per cent GOI funding in 2005-06 and 2006-07. In 2007-08, it was included under centrally sponsored plan schemes with a funding pattern of 85:15 between the GoI and states (see Annexure II).

Other state plan schemes with allocation above Rs.50 crore are the establishment of an agricultural college, the development of infrastructure for post-harvest management, the Biju Krushak Kalyan Yojna (health insurance for farming community), range administration for agriculture (to meet the running charges of an adoptive research farm at the district level and the main sale centre in each block, state potato mission, subsidy under the agriculture policy – capital investment for the establishment of commercial agricultural enterprises/agro service centres) and input subsidy on seeds, fertilisers, bio-fertilisers, insecticides, bio-pesticides, etc., for agriculture (excluding horticulture). In addition, other central plan schemes with allocation above Rs 50 crore are the National Mission on Sustainable Agriculture (NMSA) and the National Mission on Agricultural Extension and Technology (NMAET)

## 7. Conclusions and Recommendations

Based on the analysis of the state of agriculture in Odisha, we propose the following action points as the way forward.

- 1. Expanding irrigation:** Odisha has an ultimate irrigation potential (UIP) of 8.8 million hectares, out of which 3.6 million hectares can be irrigated through major and medium projects and 1 million hectares through minor flow and 4.2 through minor-lift irrigation. As of 2014-15, Odisha has managed to exploit only 48.8 per cent of major and medium irrigation potential (IPC), 70 percent of minor-flow and 28.6 per cent of minor lift irrigation. Although rich in groundwater resources, Odisha has underutilised these resources. Only 26 per cent of the total 11.9 BCM of ground water available for irrigation is being utilised. Expansion of irrigation in Odisha needs comprehensive action for the completion of ongoing major and medium projects, restoration of distribution systems where they are in disrepair, rejuvenation of tanks and other minor irrigation (flow) projects, and improvements in rural power supply for lift irrigation.
- 2. Assuring power supply for agriculture:** One of the main reasons for the underutilisation of ground water resources in Odisha is the poor state of power supply. The share of agriculture in the total sale of power is abysmally low in Odisha. Only 1.3 per cent of total sales went to agriculture in 2012-13 as compared to the national average of 22.5 per cent. The utilisation of groundwater resources can be sustained in the long run only with the supply of uninterrupted and high quality power to farmers. For realising this, the State government needs to take up a programme of strengthening of the transmission and distribution infrastructure and separation of feeders for supply of power for irrigation, taking full advantage of the funds being made available by the Government of India under the Deen Dayal Upadhaya Gram Jyoti Yojana. Additionally, the use of solar pumps needs to be popularized for supplementing the supply of power from the grid for lift irrigation. Since a large number of farmers in the state grow vegetables on small plots of land in the state, the use of micro-solar pumps will be particularly appropriate.
- 3. Providing all-weather surfaced roads:** Roads play an important role in agricultural development by connecting farmers to markets. Odisha has a high road density but for the most part these roads are not surfaced. In 2011-12, only 23.9 per cent of total road length was surfaced in Odisha, while Gujarat and Punjab had around 89 per cent of their roads surfaced. Further, 46 per cent of villages in Odisha do not have all-weather connectivity and about 62 per cent of rural roads are blacktopped and only 8.4 per cent are concrete roads. Since Odisha is subject to frequent floods, the State needs to improve the coverage of concrete roads which is more durable than black topped roads in regions where submergence is a frequent occurrence. The government needs to increase the length of all-weather surfaced roads in Odisha so that there is efficient movement of products and inputs to and from rural areas.
- 4. 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 affected particularly by recurring droughts and floods. To ameliorate the situation, drought tolerant varieties of paddy like Sahabhagi Dhan in Western Odisha and submergence tolerant varieties like Swarna sub-1 in Coastal Odisha should be popularised through the extension network to promote stress tolerant varieties and improve the productivity of paddy.

- 5. Diversifying crop production:** A large part of Odisha is mono-cropped with rice, and remains fallow after harvest during the Rabi season. It is imperative to reduce the dependence of farmers on a single crop, as the recurring climatic anomalies make agriculture production in the State doubly risky. A second crop of oilseeds, pulses, vegetables and fodder crops can be raised through by greater use of ground water resources including through the deployment of solar pumps.
- 6. Drought-proofing rain deficient areas:** Odisha needs to undertake a serious watershed management programme for drought-proofing of 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 construction of check dams, farm ponds, gully control structures and excavation of pits across the stream channel are aimed at harvesting substantial amount of runoff and increasing groundwater recharge.
- 7. Strengthening food processing infrastructure:** The share of the high value segment in the total value of agriculture and allied activities is already more than half; a major issue with high value food-items is its perishable nature. The short shelf life of these commodities makes it a risky activity due to high post-harvest losses. Cold storages and processing facilities can play an important role in minimising post-harvest losses and stimulating the growth of high value agriculture. Until 2015, Odisha had only 120 cold storages with a total capacity of 3.7 lakh MT. In comparison, Bihar had 304 cold storages with a total capacity of 14.1 lakh MT. Therefore, greater thrust should be given to development of storage and processing facilities. In order to create an environment conducive for the development of these facilities it is doubly important for the rural power supply infrastructure to be upgraded so that the industrial users, like the farmers for irrigation, get assured supply of good quality power.
- 8. Enhancing productivity of dairy segment:** With the increase in the dominance of the livestock sector, increased attention needs to be given to enhancing productivity of milk through health and reproduction management. 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, Uttar Pradesh's 1.0 MT per female animal. The low productivity of milch animals in Odisha is despite the fact that the best germ-plasm 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 semen-sexing. 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.

- 9. Developing fishery:** Odisha's 480-km long coastline has huge potential for marine fishery development, while an area of around 1 million hectares under tanks, ponds, swamps, lakes, reservoirs, rivers and canals, 32,587 hectares of cultivable brackish area, 3 lakh hectares of estuaries, brackish water and backwater areas and 93,000 hectares of the Chilika lake have potential for the development of freshwater fisheries. In order to stimulate inland fishery development public-private partnership (PPP) models should be used widely as envisioned in the Odisha Fishery Policy, 2015. Further, the availability of large wet lands offers unique opportunities for agricultural development by promoting inland fishery as well as the cultivation of makhana, water chestnut and lotus and the adoption of various combinations of integrated crop-fish-animal farming systems.

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## Annexure I: Tables

**Table 1: Geography, Demographics and Sectoral Composition**

	<b>Odisha</b>	<b>Bihar</b>	<b>Uttar Pradesh</b>	<b>Madhya Pradesh</b>	<b>Punjab</b>	<b>Gujarat</b>	<b>India</b>
Geographical Area (Million Hectares)	15.6	9.4	24.3	30.8	5.0	19.6	328.0
% of Total Geographical Area	4.7%	3.0%	7.4%	9.4%	1.5%	6.0%	100.0%
% of Gross Cropped Area	2.6%	3.8%	13.2%	11.5%	4.0%	6.5%	100.0%
Total Population (Million) : 2011	41.9	104.1	199.8	72.6	27.7%	60.4	1,200.0
% of India's Population	3.0%	9.0%	16.7%	6.1%	2.3%	4.9%	100%
Projected Population (Million): 2016	44.7	115.2	217.3	79.0	29.5%	65.5	1,305.6
Rural Population (%)	83.0%	88.5%	77.7%	72.3%	62.5%	57.4%	68.8
% of Persons Below Poverty Line: Rural[2004-05] (2011/12)	[60.8%] (35.7%)	[55.7%] (34.1%)	[42.7%] (30.4%)	[53.6%] (35.7%)	[22.1%] (7.7%)	[39.2%] (21.5%)	[41.8%] (25.7%)
Normal rainfall in Monsoon (in mm)	1,150	1,028	657	952	491	657	886.9
% of Rainfall by the South-West monsoon (June-Sept)	79.5%	85.8%	88.5% <sup>14</sup>	91.2%	79.5%	95.4%	76.8%
Agriculture Share in Total GSDP (% of Total GSDP)							
• TE 1992-93	36.0%	41.4%	40.4%	37.3%	45.0%	27.5%	30.0%
• TE 2013-14	15.4%	22.0%	28.8%	28.1%	28.0%	19.3%	14.1%
Agriculture Workforce (% of Total Workforce)							
• 2001	64.8%	77.3%	65.8%	71.5%	39.0%	51.5%	58.2
• 2011	61.8%	74.0%	59.2%	69.8%	35.6%	49.0%	55.0

\*\*\* Note: Figures given in [] gives data for 2004-05 and () for 2011-12

Source: Directorate of Economics & Statistics, Census of India and Agriculture Statistics of India, 2014

<sup>14</sup> East UP 89% and West UP 88%

**Table 2: Water Resources in Odisha**

	<b>Quantity in Billion Cubic meters BCM</b>
Availability of surface water	95.5
Storage capacity of reservoirs (major, medium minor)	17.0
Ground water resources	16.7

Sources: Annual report 2013-14, Department of Water Resources, Odisha

**Table 3: Agro-climatic zones of Odisha**

<b>Agro-Climatic Zones</b>	<b>Climate</b>	<b>Mean Annual Rainfall (in mm)</b>	<b>Soil Group</b>	<b>Irrigation Ratio (2013-14)</b>
North-western plateau	Hot & Moist	1,648	Red & Yellow	30.4%
North-central Plateau	Hot & Moist	1,535	Red Loamy	33.9%
North-eastern coastal plateau	Hot & moist sub-humid	1,568	Alluvial	60.7%
East & South-eastern Plateau	Hot & Humid	1,449	Coastal alluvial saline	53.4%
North-eastern Ghats	Hot & moist Sub-humid	1,597	Laterite and brown forest	27.4%
Eastern Ghats high land	Warm & humid	1,522	Red	32.0%
South-eastern Ghats	Warm & humid	1,522	Red, mixed red and yellow	39.3%
Western undulating	Warm & moist	1527	Black, mixed red & black	29.4%
West-central table land	Hot & moist	1527	Red, heavy textured colour	38.8%
Mid-central table land	Hot & dry sub humid	1421	Red loamy, laterite mixed red & black	35.3%

Source: National Institute of Disaster Management (NIDM)

**Table 4: Land-use Pattern**

	Gross Cropped Area (Million Ha)		Gross Irrigated Area (Million Ha)		Cropping Intensity (%)	
	TE 1992/93	TE 2012/13	TE 1992/93	TE 2012/13	TE 1992/93	TE 2012/13
Bihar	10.0 (5.4)	7.5 (3.8)	4.1 (6.3)	5.0 (5.5)	132.8	140.8
Odisha	9.6 (5.2)	8.9 (4.6)	2.4 (3.7)	3.2 (3.5)	152.1	166.7
Uttar Pradesh	25.5 (13.8)	25.8 (13.2)	15.4 (23.6)	19.9 (21.9)	147.6	155.4
Gujarat	10.7 (5.8)	12.6 (6.5)	3.0 (4.6)	5.9 (6.5)	113.9	122.8
Punjab	7.5 (4.1)	7.9 (4.0)	7.1 (10.9)	7.7 (8.5)	179.6	190.1
Madhya Pradesh	23.6 (12.8)	22.6 (11.5)	4.7 (7.2)	8.2 (9.0)	121.1	148.1
India	184.5 (100.0)	195.9 (100.0)	65.2 (100.0)	91.1 (100.0)	129.6	139.1

\*\*Figure in parentheses are percentage of All India Cropped Area, All India Irrigated area and All India Fallow land respectively

## For TE 2012-13, Data for Odisha has been taken from the Agriculture Statistics of Odisha due to inconsistent data in DES

Source: Directorate of Economics & Statistics and Several Issue of Agriculture statistics of Odisha

**Table 5: Area under major Crops in Odisha (Million Hectares)**

	Odisha		India	
	TE 1992-93	TE 2012-13	TE 1992-93	TE 2012-13
Rice	4.5 (46.5)	4.1 (45.9)	42.4 (23.0)	43.2 (22.1)
Total Cereals	4.9 (51.2)	4.6 (51.3)	101.1 (54.8)	99.4 (50.7)
Pulses	2.9 (30.4)	2.0 (22.9)	35.3 (19.1)	24.7 (12.6)
Food grains	7.8 (81.7)	6.6 (74.2)	136.4 (73.9)	124.1 (63.3)
Oilseeds	0.9 (9.6)	0.8 (8.5)	25.1 (13.6)	26.7 (13.6)

\*\*Note Figures in parenthesis gives percentage of Gross Cropped Area

\*\*Figures for TE 2012-13 is taken from Different Issues of Agriculture Statistics of Odisha due to inconsistent data in DES

*Source: Directorate of Economics & Statistics*

**Table 6: Floods since 1980s in Odisha**

Year	Number of Districts Affected	Months affected	Loss/Damage		
			Human	Livestock	Cropped Area (Lakh ha)
1980	10	Sept	82	16,669	3.2
1982	8	Aug-Sept	126	26,359	12
1984	8	June-Sept	27		3.9
1985	9	Aug-Sept	22	5281	3.1
1986	9		24	337	1.1
1991	10	July-Aug	52	1,145	6.6
1992	11	June-Aug	43	1,397	4.2
1994	20	Jul-Sept	50		10.2
1995	23	May-November	76	372	16.1
1997	18	June & Aug	29	52	5.3
1999	7	July-Aug	10		1.5
2001	24	July-Aug	102	18,149	8
2003	26	July-Oct	92	2,956	5
2006	27	July-Aug	90	1,656	2.1
2008	21	June & Sept	110	50,163	4.5
2009	15		56		1.3

## 2011 was also a flood year

Source: Department of Water resources, Odisha

**Table 7: Average Annual Growth Rates of Gross (State) Domestic Product from Agriculture and Allied Activities (1980/81 to 2013/14)**

	<b>Odisha</b>	<b>All India</b>
	<b>Average Annual Growth Rate</b>	<b>Average Annual Growth Rate</b>
1980/81 to 1989/90	4.4 (3.5)	4.4 (1.4)
1990/91 to 1999/00	-0.9 (-17.3)	3.2 (1.2)
2000/01 to 2013/14	2.8 (3.6)	3.2 (1.3)

\*\*Note: Figures in parentheses gives Coefficient of Variation

Source: Government of India, Central Statistical Organization. GSDP at Factor cost in 2004-05 prices

**Table 8: Sector-wise shares in Total value of Output from Agriculture and Livestock sector (at current prices)**

	<b>Odisha</b>		<b>India</b>	
	<b>TE 1992-93</b>	<b>TE 2013-14</b>	<b>TE 1992-93</b>	<b>TE 2013-14</b>
Food grains	39.6	23.6	32.2	20.4
Fruits & Veg	28.0	27.2	13.9	15.0
Oilseeds	8.5	1.4	9.5	5.3
Sugar	1.6	0.3	4.9	3.9
Fibre	0.7	0.9	3	3.7
Condiments & Spices	3.7	3.3	2.5	2.3
Milk	4.0	9.1	15.8	17.3
Meat	1.9	9.1	4.2	5.3
Livestock	8.2	18.7	23.9	26.1
Fishery	0.0	6.4	0	4.5

Source: Government of India, State-wise Estimates of Value of Output from Agriculture and Allied Activities

**Table 9: Sources of growth: Sectoral composition of growth in GVO of agriculture and allied activities (2001-02 to 2013-14 )**

	Food-grain	Fruits & Veg	Milk	Meat	Livestock	Fishery	GVOA
2001-02	10.3	-1.0	0.4	0.7	1.3	0.3	10.4
2002-03	-15.5	9.8	0.1	-0.1	-0.2	1.2	-5.2
2003-04	14.0	4.4	0.3	-0.2	0.1	-0.3	22.0
2004-05	-0.5	-5.1	1.4	1.7	2.8	-1.1	1.2
2005-06	1.9	-0.2	0.0	-0.5	-0.3	0.3	-0.1
2006-07	0.7	3.3	0.2	1.2	2.3	0.1	6.8
2007-08	10.4	15.9	0.9	0.8	2.2	0.3	31.1
2008-09	-1.4	-5.0	0.3	1.1	2.8	0.5	-4.0
2009-10	1.7	-2.0	0.7	2.2	3.2	0.3	5.9
2010-11	-1.7	-0.1	0.0	0.3	0.3	0.6	0.7
2011-12	-4.0	-2.1	0.3	0.2	-0.5	0.2	-3.8
2012-13	6.4	2.6	0.5	1.3	1.8	1.1	13.4
2013-14	1.0	-0.1	0.7	0.7	1.4	0.5	3.5
<b>Average growth (2001-02 to 2013-14)</b>	1.8	1.6	0.4	0.7	1.3	0.3	6.3
<b>Share of each segment in total growth in GVO</b>	28.4	24.9	7.1	11.6	21.3	4.9	100.0

Note: To determine the sources of growth, we have deflated the current series of each segment by the WPI and then decomposed the year-on-year growth in GVO 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.

Source: Calculated by authors

**Table 10: Production of Major Crops ('Million Tonnes)**

	Odisha		India	
	TE 1992/93	TE 2013/14	TE 1992/93	TE 2013/14
Rice	5.8	7.7	73.9	105.7
Pulses	1.5	1.0	18.8	18.2
Oilseeds	0.7	0.7	19.1	31.1

Source: Directorate of Economics and Statistics and Agriculture Statistics Odisha, Several Issues

**Table 11: Productivity of Major Crops (Metric Tonnes/hectare)**

	Odisha		India	
	TE 1992/93	TE 2013/14	TE 1992/93	TE 2013/14
Rice	1.3	2.1	1.7	2.4
Pulses	0.5	0.5	0.5	0.8
Oilseeds	0.7	0.9	0.8	1.2

Source: Directorate of Economics and Statistics and National Horticultural Database

**Table 12: Production and Productivity of Fruits and Vegetables TE 2013-14**

	Fruits		Vegetables		Total Fruits & Vegetables	
	Production (Million tonnes)	Productivity (Metric Tonnes/Hectare)	Production (Million tonnes)	Productivity (Metric Tonnes/Hectare)	Production (Million tonnes)	Productivity (Metric Tonnes/Hectare)
Gujarat	8.0 (9.7)	21.7	10.7 (6.7)	19.6	18.7 (7.7)	24.6
Uttar Pradesh	6.0 (7.2)	17.1	18.9 (11.8)	21.6	24.8 (10.2)	22.3
Madhya Pradesh	4.8 (5.9)	25.7	11.9 (7.4)	20.4	16.7 (6.9)	25.5
Bihar	4.1 (4.9)	13.5	15.7 (9.8)	18.5	19.7 (8.1)	18.1
Odisha	2.2 (2.6)	6.6	9.5 (5.9)	13.8	11.6 (4.8)	11.3
Punjab	1.5 (1.8)	20.0	3.8 (2.4)	20.6	5.3 (2.2)	21.0
India	82.2 (100.0)	11.8	160.5 (100.0)	17.4	242.7 (100.0)	15.0

\*\*Figures in parenthesis are percentage of respective total vegetable production in the country

Source: National Horticulture Database, several issues

**Table 13: Production and Productivity of Vegetables in Odisha**

	Odisha				India			
	Production (Million tonnes)		Productivity (Metric Tonnes/hectare)		Production (Million tonnes)		Productivity (Metric Tonnes/hectare)	
	TE 2007-08	TE 2013-14	TE 2007-08	TE 2013-14	TE 2007-08	TE 2013-14	TE 2007-08	TE 2013-14
Brinjal	1.9 (20.1)	2.2 (16.5)	14.8	17.0	9.5 (100.0)	13.2 (100.0)	17.3	18.7
Cabbage	0.9 (4.7)	1.2 (13.3)	27.6	28.0	20.0 (100.0)	8.7 (100.0)	21.9	22.4
Cauliflower	0.6 (11.5)	0.7 (8.5)	14.2	15.1	5.6 (100.0)	7.9 (100.0)	18.6	19.4
Okra	0.6 (15.2)	0.6 (9.6)	8.7	9.1	4.1 (100.0)	6.3 (100.0)	10.8	12.0
Tomatoes	1.3 (13.3)	1.4 (7.5)	13.3	14.3	10.0 (100.0)	18.5 (100.0)	19.2	20.8
Sweet Potatoes	0.4 (36.7)	0.4 (37.0)	8.5	9.4	1.1 (100.0)	1.1 (100.0)	9.1	10.0
Others	2.3 (3.5)	3.1 (2.9)	9.9	11.6	67.2 (100.0)	105.4 (100.0)	12.6	17.1
Total Veg	8.1 (6.9)	9.5 (5.9)	12.4	13.8	117.4 (100.0)	161.1 (100.0)	16.7	17.4

\*\*Figures in parenthesis are percentage of respective total vegetable production in the country

Source: National Horticultural Database, several issues

**Table 14: Production and Productivity of Fruits in Odisha**

	Odisha				India			
	Production (Million tonnes)		Productivity (Metric Tonnes/hectare)		Production (Million tonnes)		Productivity (Metric Tonnes/hectare)	
	TE 2007-08	TE 2013-14	TE 2007-08	TE 2013-14	TE 2007-08	TE 2013-14	TE 2007-08	TE 2013-14
Citrus	0.2 (3.0)	0.3 (2.8)	7.8	9.7	7.0 (100.0)	9.7 (100.0)	8.7	9.6
Litchi	0.01 (3.0)	0.02 (3.6)	3.1	4.5	0.4 (100.0)	0.6 (100.0)	6.1	6.9
Mango	0.4 (2.8)	0.7 (4.2)	2.7	3.7	13.4 (100.0)	17.5 (100.0)	6.3	7.1
Others	0.8 (2.0)	1.1 (2.1)	9.1	11.6	38.7 (100.0)	54.4 (100.0)	6.2	15.9
Total Fruits	1.4 (2.3)	2.2 (2.6)	5.4	6.6	59.5 (100.0)	82.2 (100.0)	16.2	11.8

\*\*Figures in parenthesis give percentage of respective total fruit production in the country

Source: National Horticulture Database, several issues

**Table 15: Livestock and Poultry Population in Odisha**

	Million Numbers	
	1991 Census	2007 Census
Cattle	13.6	12.3
Buffalo	1.5	1.2
Sheep	1.8	1.8
Goat	4.8	7.1
Pigs	0.6	0.6
Total Livestock	22.3	23.1
Poultry	13.1	20.6

Source: Economic Survey of Odisha, 2014-15

**Table 16: Total Meat Production ('000 MT)**

	<b>Cattle</b>	<b>Sheep</b>	<b>Goat</b>	<b>Pig</b>	<b>Poultry</b>	<b>Total Meat</b>
2008-09	0.2 (0.2)	10.7 (9.0)	46.3 (39.1)	8.2 (6.9)	53 (44.8)	118.3 (100.0)
2009-10		12.4 (9.7)	46.3 (36.2)	10.6 (8.3)	58.7 (45.9)	127.9 (100.0)
2010-11		12.6 (9.1)	49.8 (36.1)	11.7 (8.5)	63.9 (46.3)	138.1 (100.0)
2011-12		12.1 (8.8)	52.3 (37.9)	11.0 (8.0)	62.0 (45.0)	137.9 (100.0)
2012-13		11.6 (8.3)	53.9 (38.2)	10.3 (7.3)	65.0 (46.2)	140.9 (100.0)

\*\*Figures in parenthesis gives percentage of total animal meat produced in the State

Source: Department of Animal husbandry

**Table 17: State-wise Meat production '000 tonnes**

	<b>2008-09</b>			<b>2011-12</b>			<b>CAGR 2008-09 to 2011-12</b>		
	<b>Poultry</b>	<b>Goat</b>	<b>Total Meat</b>	<b>Poultry</b>	<b>Goat</b>	<b>Total Meat</b>	<b>Poultry</b>	<b>Goat</b>	<b>Total Meat</b>
Bihar	25.7 (1.4)	61.9 (7.9)	209.2 (4.9)	37.0 (1.5)	63.0 (6.9)	227.8 (4.1)	9.6%	0.4%	2.2%
Gujarat	15.5 (0.8)	1.6 (0.2)	19.5 (0.5)	31.0 (1.2)	1.4 (0.1)	35.3 (0.6)	19.0%	-3.9%	16.1%
Madhya Pradesh	10.9 (0.6)	9.6 (1.2)	34.1 (0.8)	13.0 (0.5)	10.8 (1.2)	39.4 (0.7)	4.6%	3.2%	3.7%
Odisha	53.0 (2.8)	46.3 (5.9)	118.3 (2.8)	62.0 (2.5)	52.3 (5.8)	137.9 (2.5)	4.0%	3.1%	3.9%
Uttar Pradesh	202.6 (10.8)	176.3 (22.4)	767.3 (17.9)	175.0 (7.0)	182.0 (20.0)	955.6 (17.3)	-3.6%	0.8%	5.6%
India	1,884.4 (100.0)	785.8 (100.0)	4,279.6 (100.0)	2,483.1 (100.0)	908.4 (100.0)	5,514.3 (100.0)	7.1%	3.7%	6.5%

Source: Basic Animal Husbandry & Fisheries Statistics, 2014

\*\*Figures in parenthesis are share in total production of India's Poultry, Goat and Total Meat production respectively

**Table 18: State-wise Milk Production ('000 MT)**

	<b>TE 2002-03</b>	<b>TE 2010-11</b>	<b>TE 2013-14</b>	<b>CAGR 2000-01 to 2013-14 (%)</b>	<b>Milch Animals 2007 Census [Cows and Buffaloes '000 Number]</b>
Uttar Pradesh	14,597.7 (17.4)	20,257.0 (17.3)	23,360.0 (17.6)	4.10%	18,501.0 (14.5)
Gujarat	5,754.3 (6.9)	8,850.3 (7.6)	10,414.7 (7.8)	5.40%	7,655.0 (6.0)
Punjab	7,960.7 (9.5)	9,399.7 (8.0)	9,758.7 (7.4)	1.80%	3,851.0 (3.0)
Madhya Pradesh	5,129.0 (6.1)	7,178.7 (6.1)	8,862.0 (6.7)	5.10%	12,900.0 (10.1)
Bihar	2,674.0 (3.2)	6,191.7 (5.3)	6,894.7 (5.2)	7.90%	8,544.0 (6.7)
Odisha	915.3 (1.1)	1,640.0 (1.4)	1,768.7 (1.3)	5.50%	4,053.0 (3.2)
India	83,724.0 (100.0)	116,818.7 (100.0)	132,673.3 (100.0)	3.90%	127,390.0 (100.0)

\*\*Figures in parenthesis are share in total production of Milk and total milk animals

Source: National Dairy Development Board

**Table 19: State-wise Fish Production ('000 Tonnes)**

	<b>TE 2002-03</b>	<b>TE 2006-07</b>	<b>TE 2013-14</b>
Andhra Pradesh	697.9 (11.8)	867.0 (13.2)	1,809.9 (19.9)
West Bengal	1,093.4 (18.4)	1,274.7 (19.4)	1,514.2 (16.7)
Gujarat	713.4 (12.0)	705.5 (10.7)	790.2 (8.7)
Kerala	667.3 (11.8)	664.3 (10.1)	693.9 (7.6)
Tamil Nadu	468.0 (7.9)	488.2 (7.4)	618.7 (6.8)
Maharashtra	525.8 (8.9)	574.8 (8.7)	589.3 (6.5)
Uttar Pradesh	227.8 (3.8)	291.1 (4.4)	448.0 (4.9)
Odisha	276.4 (4.7)	327.7 (5.0)	401.9 (4.4)
Bihar	241.2 (4.1)	271.4 (4.1)	392.3 (4.3)
Punjab	58.7 (1.0)	83.3 (1.3)	100.3 (1.1)
Madhya Pradesh	46.2 (0.8)	62.7 (1.0)	85.6 (0.9)
India	5,937.0 (100.0)	6,581.8 (100.0)	9,094.5 (100.0)

## Figures in parenthesis give the shares in total production of fish in the country

Source: *Indiastat*

**Table 20: Correlation Matrix**

	GDPA	SW Rainfall	Terms of trade	Irrigation Ratio	Certified Seeds (kg/ha)	Fertiliser Consumption (Kg/ha)	Power Consumption	Diversification <sup>##</sup>	Total Road Density
GDPA	1.000								
SW Rainfall	0.32	1.000							
Terms of trade	0.78***	-0.13	1.000						
Irrigation Ratio	0.878***	0.56**	0.46	1.000					
Certified Seeds (kg/ha)	0.76***	-0.019	0.93***	0.52*	1.000				
Fertiliser Consumption (Kg/ha)	0.88***	0.05	0.79***	0.71***	0.86***	1.000			
Power Consumption	0.11	-0.38	0.41	-0.03	0.56**	0.57**	1.000		
Diversification <sup>##</sup>	0.59**	0.54*	0.12	0.67**	0.26	0.28	0.07	1.00	
Total Road Density	0.88***	-0.04	0.94***	0.60**	0.84***	0.80***	0.25	0.43	1.000

\*\*\* Significant at 1% \*\*significant at 5% \* significant at 10 per cent ## Variables are in log form

##Diversification: Value of fruits Vegetables and floriculture as a per cent of total value of Agriculture & Allied Activities

Source: Calculated by Authors

**Table 21: Regression results of agriculture growth in Odisha: 2000-01 to 2012-13**

<b>VARIABLES</b>	<b>Model</b>
	<b>GDPA</b>
Irrigation	<b>0.48***</b> (0.07)
Diversification	<b>0.13**</b> (0.06)
Total Road Density	<b>0.89***</b> (0.08)
Constant	<b>5.9***</b> (0.59)
Observations	13
R-squared	0.97
Adjusted R squared	0.96

\*\*\* significant at 1 per cent, \*\* significant at 5 per cent and \* significant at 10 per cent. Figure in parenthesis are robust standard error

Source: *Estimated by Authors*

**Table 22: Augmented Dickey Fuller test (ADF)**

<b>Variable</b>	<b>Augmented Dickey Fuller Test</b>	
	<b>Level (Coefficient)</b>	<b>First-Difference (Coefficient)</b>
Log(GDPA)	-0.21	-1.7***
Log (Irrigation Ratio)	-0.38	-1.4***
Log (Diversification)	-1.5***	-1.7***
Log( Road Density)	0.09	-1.5***

\*\* p < 0.01. \* p < 0.05. \* p < 0.1. The null hypothesis is that the series is non-stationary.

Source: *Estimated by Authors*

**Table 23: Kwiatkowski–Phillips–Schmidt–Shin test (KPSS)**

	Lag	Test Statistics	Critical Value at 1% level of significance
Level	6	0.262***	0.216
First Difference	3	0.165	0.216

Source: Estimated by Authors

\*\*  $p < 0.01$ . \*  $p < 0.05$ . \*  $p < 0.1$ . The null hypothesis is that the series is stationary

**Table 24: Co-integration Result - ADF on Residuals**

	Augmented Dickey Fuller Test
Variable	Level (Coefficient)
Residuals	-1.18***

Source: Estimated by Authors

**Table 25: Irrigation ratio (Gross Irrigated to Gross Cropped Area)**

	TE 1992-93	TE 2006-07	TE 2012-13
Punjab	94.4	97.4	98.2
Uttar Pradesh	60.4	74.9	77.2
Bihar	41.4	58.5	65.9
Odisha	25.4	33.4	35.6
Gujarat	28.1	41.4	47.0
Madhya Pradesh	19.9	31.1	36.3

Source: Directorate of Economics & Statistics

**Table 26: Ultimate Irrigation Potential and Achievement: State-wise (million hectares)**

	Ultimate Irrigation Potential (UIP)				Cumulative Achievement up to 10th plan (2002-07) IPC			% IPC to UIP	
	Major & Medium	Minor		Total	Major & Medium	Minor	Total		
		Flow	Lift						Total Minor
Gujarat	3.0	0.3	2.8	3.1	6.1	2.2	2.0	4.2	69.6
Bihar	5.2	1.5	4.1	5.7	10.9	2.9	4.8	7.6	70.1
Madhya Pradesh	4.9	2.1	9.3	11.4	16.2	1.9	2.3	4.3	26.4
Orissa	3.6	1.0	4.2	5.2	8.8	2.0	1.6	3.6	41.2
Punjab	3.0	0.1	2.9	3.0	6.0	2.6	3.4	6.0	100.6
Uttar Pradesh	12.2	1.2	16.3	17.5	29.6	8.8	23.6	32.4	109.3
India	58.5	17.3	64.1	81.4	139.9	41.6	60.1	101.7	72.7

Source: Water Related Statistics, 2015

**Table 27: Odisha - Potential Irrigation Created and Utilised (Million Hectares)**

	Major & Medium Sector	Minor Sector (Flow)	Minor Sector (lift)	Other Sources	Total Potential Created	Total Potential Utilised	% IPU to IPC
2006-07	1.8	0.6	0.7	1.0	4.1	3.2	78.0
2007-08	1.8	0.6	0.7	1.0	4.1	3.3	80.5
2008-09	1.9	0.6	0.7	1.0	4.2	3.2	74.3
2009-10	1.9	0.6	0.8	1.1	4.4	3.0	68.5
2010-11	2.0	0.6	0.8	1.1	4.5	3.1	68.8
2011-12	2.0	0.7	0.8	1.1	4.6	3.1	67.3
2012-13	2.0	0.7	0.9	1.1	4.6	3.4	71.6
2013-14	2.0	0.7	1.1	1.2	4.9	3.5	71.4
2014-15	2.0	0.7	1.2	1.2	5.1		
Ultimate Irrigation Potential (UIP) Odisha	4.1	1.0	4.2		8.8		
Percentage IPC to UIP 2014-15	48.8%	70%	28.6%		58.0%		

Source: Department of Water resources, Odisha

**Table 28: Availability of Ground Water for Future Irrigation use and Stage of Ground Water Development in Selected States**

	Ground Water Availability for Irrigation (in BCM)	Stage of Ground Water Development (%)
Bihar	13.9	43.0
Gujarat	5.32	75.0
Madhya Pradesh	13.8	56.0
Orissa	11.9	26.0
Punjab	-14.6	170.0
Uttar Pradesh	17.2	72.0
India	153.7	61.0

Source: *Ground Water Year Book, 2013-14*

**Table 29: Share of Agriculture in total sales of power in selected states**

	2009-10	2010-11	2011-12	2012-13	2013-14
Bihar	13.1	6.3	5.4	6.1	6.1
Gujarat	28.0	26.5	25.4	25.1	24.7
Madhya Pradesh	30.0	30.6	31.4	35.3	33.7
Odisha	1.2	1.4	1.3		NA
Punjab	32.5	30.3	29.3	30.3	30.1
Uttar Pradesh	17.4	17.3	17.3	17.2	16.3
India	23.2	21.6	22.7	23.3	22.5

Source: *Annual report (2013-14) on the Working of State Power Utilities & Electricity Departments, Planning and Energy Division of Planning Commission*

**Table 30: Status of Road Development – Total Road Density and Surfaced Road Density**

	Total Road density (per 1000 sq km)		Surfaced Road density (per 1000 sq km)		Surfaced Roads (% of total Roads)	
	2004	2012	2004	2012	2004	2012
Bihar	783.8	1,488.5	302.5	1,241	38.6	47.2
Punjab	908.1	1,862.5	628.2	1661.1	69.2	89.2
Uttar Pradesh	1,014.7	1,673.3	755.7	1288.5	74.5	77.0
Orissa	1,373.3	1,635.9	209.8	390.8	15.3	23.9
Gujarat	733.0	747.8	663.2	747.8	90.5	89.8
Madhya Pradesh	536.5	653.0	261.7	401.9	48.8	61.5
India	812.2	1,206.3	464.2	765.2	57.2	63.4

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

## **Annexure II: Policies and Programmes**

In this section, we briefly discuss the main state and central schemes that have been implemented in each segment – horticulture, food grains, livestock and poultry in Odisha. Under the horticulture segment, we discuss a) National Horticulture Mission, b) horticulture component of Odisha's State Agriculture Policy (2013) and c) Model Act. Under the food grains segment, we discuss a) National Food Security Mission, and c) Food-grain segment of Odisha State Agriculture Policy (2013). Finally, for the livestock and poultry segment, we discuss the salient features of Odisha's 1) poultry policy (2015), b) bovine policy, c) livestock policy and d) benefits under Odisha State Agriculture Policy-2013.

### **a. Horticulture Sector**

In terms of policies and programmes, the National Horticulture Mission, the Odisha State Agriculture Policy (2013) and the Model APMC act have played important roles in boosting the horticulture segment in Odisha. In the following section, we briefly discuss these programmes in Odisha.

#### **(i) National Horticulture Mission**

The centrally sponsored National Horticulture Mission (NHM) was initiated in 2005-06, initially covering 16 districts, but it was scaled up to 24 districts in 2007-08. The scheme has been subsumed as a part of Mission for Integrated Development of Horticulture (MIDH) from 2014-15. As per the NHM mandate, 85 per cent of the fund requirements for the mission districts is provided by the centre and remaining 15 per cent by the state government. The focus crops under the programme include mango, citrus, litchi, banana, cashew, betel vine, ginger, turmeric, flowers and medicinal plants and aromatic plants.

The major activities being undertaken in the project are production and distribution of planting material, vegetable seed production, area expansion, rejuvenation of old and senile orchards, creation of community water resources, protected cultivation, promotion of integrated pest management (IPM)/ integrated nutrient management (INM), organic farming, and development of post-harvest management and marketing infrastructure, and human resource development.

Since its inception in 2005, the mission has been able to cover 178.7 thousand hectares of land under horticulture crops and another 3.1 thousand hectares under rejuvenated orchards. Organic farming has been adopted in 49 thousand hectares to promote organic cultivation of horticultural crops. Under the component of post-harvest management, 3,131 units including pack houses, cold storage units, refrigerated vans, primary/mobile processing units, ripening chambers, pre-cooling units attached to cold storages and mobile pre-cooling units have been established. Moreover, 42 markets have been set up.

**Table 31: Physical Achievements of National Horticulture Mission**

(Cumulative from 2005-06 to 2013-14)	Area Covered under Horticulture Crops ('000 Hectare)		Rejuvenation of Orchards ('000 Hectare)		Nurseries-Public and Private (Number)	
	Target	Achievement	Target	Achievement	Target	Achievement
Bihar	47.7	50.5	15.9	1.0	61	86
Odisha	140.8	178.7	10.5	3.1	193	255
Gujarat	96.1	113.0	5.0	2.3	96	88
Punjab	39.4	39.1	11.0	10.3	15	20
Uttar Pradesh	116.9	142.3	22.7	10.9	79	81
Madhya Pradesh	125.7	139.3	14.3	14.1	197	178

Source: *Indiastat*<sup>15</sup>

In addition to the centrally sponsored NHM, the state government has initiated several schemes to promote horticulture. These are as follows:

- 1) **Strengthening of School of Horticulture:** It provides training facilities to unemployed youth under NHM and provides training to field staff under the Directorate of Horticulture
- 2) **Input Subsidy:** To ensure that quality planting material is utilised, the government subsidises the cost of planting material purchased from the Horticulture Department's farms or nurseries and registered private nurseries according to the NHM assistance pattern to both mission and non-mission districts.<sup>16</sup> As per the scheme, a minimum of five plants per beneficiary is to be supplied at 75 per cent subsidy on planting material only
- 3) **Development of Potato, Vegetables and Spices:** In order to encourage farmers to take up cultivation of potato and other vegetables, quality seeds were sold at subsidised rates
- 4) **Horticulture Programme in Non-Mission Districts:** In the remaining 6 districts not covered by the NHM, the state government provides all the NHM benefits under the scheme 'Horticulture Programme for Non-Mission Districts'. This programme envisages establishment of new gardens of fruits (mango, citrus, banana sucker and cashew plantation) and flowers (marigold, gladioli and rose), organic farming (establishment of vermi compost units), training activities, etc., in non-mission districts on the pattern of the National Horticulture Mission. In addition, as an integral part of the scheme, the state government is focusing on human resource development through exposure visits of progressive farmers to other states, and by organising workshops and training camps in the non-mission districts. Since 2005-06, four state level shows and 50 district level shows were organised by the state government and 13,150 farmers were given training within the state and 3,553 farmers were sent for exposure visits to other states (Department of Horticulture Odisha).

<sup>15</sup> The official website that gives information on Annual Achievements of NHM was down during the time of analysis. <http://nhm.dacnet.nic.in/feedback/AllIndiaReports.aspx>

<sup>16</sup> Minimum 5 plants per beneficiary is supplied at 75% subsidy on planting material

- 5) **Establishment and Revival of Block Level Nurseries:** The state government has initiated a scheme in all districts to establish and revive nurseries at the block level.
- 6) **Intercropping in fruit orchards:** Further, the government is focusing on intercropping fruit orchards with pineapple or root and tuber crops in an attempt to provide assured short-term benefit to farmers because newly established perennial orchards begin to give returns only after four to five years.

**(ii) Odisha State Agriculture Policy-2013 (OSAP)**

Besides these state plans and schemes, farmers can also avail assistance under Odisha's State Agriculture Policy (OSAP) 2013. The state agriculture policy provides subsidies to farmers to develop nurseries, vegetable seed production centres and seed infrastructure.

To develop model nurseries (two to four hectare), the OSAP provides 100 per cent assistance to the public sector at Rs.0.625 million/ ha and in the case of the private sector, credit linked back-end subsidy at 50 per cent of cost, subject to a maximum of Rs.1.25 million per unit for a maximum of four hectare as project based activity. To develop small nurseries (one hectare), OSAP provides 100 per cent funding to the public sector at Rs.0.625 million per hectare and in the case of the private sector, credit linked back-ended subsidy at 50 per cent of cost, subject to a maximum of Rs.0.312 million/unit, as project based activity.

Further, to develop vegetable seed production and creation of seed infrastructure, the state agriculture policy provides 100 per cent funding to public sector institutes such as ICAR, SAU, state department, etc. Private sector institutes can avail subsidies up to 50 percent of cost, limited to Rs.25000 per hectare. (limited to 5 ha per beneficiary) for vegetable seed production and a credit-linked back-ended subsidy of 50 per cent of cost for seed infrastructure development.

In order to boost vegetable cultivation, OSAP provides a maximum assistance of Rs.22,500 (75 per cent) per hectare for open pollinated cultivation and Rs.33,750 (75 per cent) per hectare for hybrid vegetable cultivation.

To encourage fruit production in the state, the OSAP provides assistance for the development of perennial fruit orchards such as mango, litchi, citrus fruits and non-perennial fruits such as banana. To develop perennial fruit orchards, a farmer can avail a maximum assistance Rs.22,000 per hectare for mango, Rs.29,230 per hectare for litchi, Rs.21,950 per hectare for guava, Rs.37,000 per hectare for sapota, Rs.35,340 for orange and lime (75 per cent of cost of meeting the expenditure on planting material and cost of inputs in 3 instalments of 60:20:20 subject to survival rate of 75 per cent in the 2nd year and 90 per cent in the 3rd year). To develop non-perennial orchards, the OSAP gives a maximum assistance of Rs.22,500 per hectare for banana sucker development and Rs.32,500 per hectare for pineapple sucker development (50 per cent of cost of meeting the expenditure on planting material and cost of inputs in 2 instalments of 75:25, subject to a survival rate of 90 per cent in the 2nd year)

OSAP also promotes floriculture by providing assistance to farmers growing cut flowers (rose and marigold), tuberous flowers (gladioli) and loose flowers. Rose cultivators can avail a maximum assistance of Rs.2,50,000 per ha (50 per cent of the cost of meeting expenditure on planting material and cost of inputs), which is limited to 1 hectare per beneficiary. Marigold cultivators can avail a maximum assistance of Rs.57,500 per hectare (50 per cent of the cost of meeting the expenditure on planting material and cost of inputs), which is limited to 1 hectare per beneficiary. Tube rose and jasmine cultivators can avail a maximum assistance of Rs.60,000 per hectare (50 per cent of the cost of meeting the expenditure on planting material and cost of inputs), which is limited to 1 hectare per beneficiary.

Further, there are a number of other centrally sponsored schemes other than the NHM, which focus on the production of hybrid coconut seedlings, establishment of regional coconut nurseries, incentivising micro irrigation and establishing oil palm plantations.

Given the state's efforts to promote horticulture in Odisha, the state received an award for the best performing state under NHM in 2012. Despite these efforts and progress in fruit and vegetable cultivation, Odisha's productivity in fruit and vegetable cultivation is lower than the national average. In TE 2013-14, Odisha's productivity in fruit cultivation was 6.6 MT per hectare as compared to the national average of 13.8 MT per hectare; similarly, vegetable productivity in Odisha was 13.9 MT per hectare as compared to the national average of 17.4 MT per hectare. However, to its credit, Odisha's productivity in fruit cultivation is increasing gradually. It has increased from 5.4 MT per hectare in TE 2007-08 to 6.6 MT per hectare in TE 2013-14. Similarly, vegetable productivity has slowly risen from 12.4 MT per hectare to 13.8 MT per hectare in the same time period. However, there is a lot of variation within sub-groups.

### **(iii) Model APMC Act**

An efficient agricultural marketing system is the back bone of the agriculture sector. Agricultural marketing in India is governed by the Agricultural Produce Marketing Acts of various state governments. The APMC Act empowers state governments to notify the commodities and designated markets where farmers can sell their produce. In other words, the APMC Act makes first sale of specified commodities outside the notified market yards illegal. Further, APMCs allows the imposition of levies and other market charges on every first sale of commodity produced. In addition to these charges by the state, commission agents appointed by the APMCs charge a market fee; usually, the market fees are passed on to farmers who sell their produce in the market. In 2003, in an attempt to remove trade barriers and to create a common market, the central government formulated a Model Act for adoption by states. The Model Act allows farmers to sell their produce directly to buyers without going through the APMC and allows alternate markets such as direct purchase centres and private market yards. It also allows public private partnerships in the 'management and development' of agricultural markets in the country for post-harvest handling, cold storage, pre-cooling facilities, pack houses etc. The Model Act encourages processors, exporters, and packagers to engage in contract farming and provides for dispute resolution.

Since Agriculture is a ‘state subject’, it is the discretion of the state to implement the Model APMC Act. Currently, 16 states are implementing Model APMC. Bihar is the only state that has repealed the APMC Act (2006). The present agricultural marketing system in Odisha is governed by the Odisha State Agriculture Produce marketing Act. Table 32 summarises the various stages of implementation of the Model APMC Act in Odisha and the comparator states. As per the recommendations of the Model APMC Act, Odisha has initiated the establishment of private markets, facilitated the direct purchase of agricultural produce from farmers by processor/bulk buyer/bulk retailer/exporter, made provisions for contract farming and delisted fruits and vegetable from market fee. It has to still initiate e-trading, establish farmer/consumer markets managed by person other than market committee, and provide for a single point levy of market fee and single registration or licence for trade. Odisha set up 43 Krushak Bazars (farmer markets) in 24 districts to help farmers sell their agricultural products directly to consumers. This is a direct marketing model like ‘Apni Mandi’ in Punjab and ‘Rayatu Bazar’ in Andhra Pradesh. Of these 43 Krushak Bazars, 32 are functional (Odisha State Agricultural Marketing Board).

**Table 32: Status of Model APMC Act**

	Punjab	Gujarat	Madhya Pradesh	Odisha	Uttar Pradesh	Bihar
Establishment of private markets/private markets managed by persons other than market committee	Yes	Yes	No	Yes (Excluding Rice)		APMC Act repealed in 2006
Direct purchase of agricultural produce from agriculturist by processor/bulk buyer/bulk retailer/exporter	Yes	Yes	Yes	Yes	Only for bulk purchase under executive order issued from time to time	
To promote and permit e-trading	No	Yes	Yes	No		
Establishment of farmers’/consumers’ market managed by a person other than a market committee (direct sale by the producer)	No	Yes	No	No		
Contract farming provision	Yes	Yes	Yes	Yes		
Single point levy of market fee	Yes	Yes (for processor, grader, packer, value addition and exporter)	Yes	No		
Single registration/licence for trade/transaction in more than one market	No	Yes	Yes	No		
Deregulation/exemption of market fee on Fruits & Vegetables	No	No	Deregulated outside market yard (except banana) since 2012	Delisting fruits & veg since 2015		

Source: SFAC

## **b. Food grain sector**

There are several state and central programmes that aim to improve productivity of food grain farming in Odisha. We briefly discuss the National Food-Security Mission and the food grain specific interventions under Odisha state agriculture policy.

### **(i) National Food Security Mission**

The National Food Security Mission, a centrally sponsored scheme, is one of the main programmes to improve production and productivity of food grains. It was initiated in Odisha and 15 other states in 2007. In Odisha, NFSM-Rice is being implemented in eight districts, NFSM pulses in 30 districts and NFSM coarse cereals in six districts. The main objective of the programme is to bridge the yield gap in these crops through dissemination of improved technologies and farm management practices. The focus of NFSM is on providing the following:

- a) Farm level demonstration on (i) hybrid rice cultivation, (ii) direct seed rice, (iii) line transplanting, (iv) system rice intensification (SRI), (v) Swarna Sub-1/Sabhagi Dhan, (vi) intercropping system such as rice and pulses.
- b) Distribution of hybrid seeds and HYV seeds
- c) Soil management through application of micro-nutrients and liming in acidic soil
- d) Plant protection through application of chemicals and bio-agents, bio-fertilisers, weedicides
- e) Farm mechanisation: The NFSM provides assistance for the following machines: conoweeder, manual sprayer (knap sack sprayer/foot operated sprayer), drum seeder for rice, power sprayer, chiseller (deep ploughing), tractor mounted Sprayer, Seed Drill, Zero till seed drill, multi-crop planter, ridge furrow planter, power weeder, power driven chaff cutter, rotavator/turbo seeder, paddy thresher/multi crop thresher, laser land leveler, seed propelled paddy transplanter.
- f) Incentives to increase water application tools like dug wells, bore wells and lift irrigation: The NFSM provides assistance for pump sets up to 10 HP, sprinkler set, water carrying pipes and mobile rain gun.

Odisha has received the Krishi Karman Award in four years out of five since the inception of the award. The award was instituted under the National Food security Mission in 2010-11 to reward the best performing state in total food-grains and individual crops of Rice, Wheat, Pulses and Coarse Cereals. Krishi Karman Award comprises of three awards for total food-grain production and four awards for production of rice, wheat, coarse cereals and pulses. The states are divided into three groups based on the highest production levels of food-grains achieved by the States in the five years prior to the initiation of the award. These categories are: Category 1: where production is greater than 10 million tonnes (Uttar Pradesh, Punjab,

Andhra Pradesh, West Bengal, Haryana, Madhya Pradesh, Rajasthan, Maharashtra, Karnataka and Bihar); Category 2: where production is between 1-10 million tonnes (Odisha, Tamil Nadu, Gujarat, Chattisgarh, Assam, Jharkhand, Uttarakhand, Himachal Pradesh and Jammu & Kashmir; and Category 3- where production is less than 1 million tonnes (Rest of the states).

## **(ii) Odisha State Agriculture Policy-2013 (OSAP)**

In addition to the central programme, the state Government came out with the State Agriculture Policy in 2013 to improve the productivity of agriculture in Odisha and to shift current level of subsistence agriculture to a profitable commercial agriculture by enhancing seed replacement rate, availability of quality planting material, integrated nutrient and pest management, water management, farm mechanisation and technological transfer. We briefly discuss the salient features of OSAP that focuses on food grain production.

### **• Seeds**

As per the OSAP, the state government intends to improve the seed replacement rate from the current level of 22 per cent (rice) by increasing production to 1.2 million quintals of certified seeds by emphasising seed village schemes. Further, in order to achieve this goal, the government is providing incentives to private seed entrepreneurs to increase the production of high yielding varieties of seeds and hybrid seeds. The government also intends to establish processing plants along with storage godowns in every district. The OSAP provides 100 per cent assistance to establish seed infrastructure (project-based maximum Rs.20 million per project) for public sector initiatives and credit-linked, back-ended subsidy at 50 per cent of the cost of project to private entrepreneurs. Moreover, in order to facilitate up-take of certified seeds by farmers, the government intends to open seed sale centres in each gram panchayat through a network of private seed dealers.

### **• Irrigation**

To improve the irrigation situation in Odisha, the OSAP commits to speedy completion of ongoing major and medium projects and to promote participatory irrigation management (PIM) through the pani panchayat system. The government intends to irrigate 35 per cent of cultivable land in each block. In order to do so, the government will be focusing on renovation and creation of tanks in every village having such potential; individual tube-wells and bore wells will be promoted under the Jananidhi programme.

As per the Jananidhi programme, all farmers irrespective of size of holdings are entitled to financial incentives. The persons who are entitled include individuals, a body of individuals, registered NGOs, and companies encouraging contract farming in farmer's lands. Beneficiaries can avail assistance up to 50 per cent of project cost subject to a limit of Rs.20,000 for shallow tube-well (STW) establishment. In addition, in the case of a cluster of 10 or more SRWs, the cost of electrification will be borne by the government subject to a ceiling of Rs 0.4 million per cluster. For dug-wells, beneficiaries can avail of assistance up to

75 per cent of project cost subject to a limit of Rs.75,000. For setting up bore-wells, beneficiaries can avail 75 per cent of project cost subject to a limit of Rs.50,000 (excluding cost of electrification). In addition, 75 per cent of genset/electrification cost, subject to a limit of Rs.50,000 (for energisation). The Jalanidhi programme also provides assistance for river lift/surface lift projects. Beneficiaries can avail of 75 per cent of the project cost subject to a limit of Rs.60,000. Further, community-based/registered bodies can avail of 90 per cent subsidy provided the minimum coverage is 40 hectares.

The state also intends to expand micro-irrigation by providing subsidies for drip and sprinkler irrigation maximum up to 90 per cent of the cost. The cost of subsidising drip and sprinkler irrigation is shared by the centre, state and beneficiary in the ratio of 40:40:20 for general farmers and 50:40:10 for small and medium farmers.

- **Farm Mechanisation**

In order to improve farm machine uptake in the state, the state and central government is providing several assistance packages for different machines. Framers can avail of 50 per cent of the cost of tractors (40 PTO HP), limited to Rs.90,000, 50 per cent of the cost of power tillers (of 8 BHP and above) limited to Rs.75,000 and 50 per cent of cost of light-weight power tillers, limited to Rs.40,000. Further, the government also subsidises self-propelled reaper, paddy transplanter, power driven equipments, manually and animal operated implements, power threshers, diesel/electric/petrol/kerosene pump sets, laser guided levellers and combine harvesters

- **Soil Testing and Restoration of Soil Health Fertility**

The OSAP also highlights the importance of soil health management through soil health cards. The state intends to increase the number of static and mobile soil testing laboratories in Odisha so that farmers can take their soil sample and get feedback on nutrient management. Further, for acid soil management, the government provides assistance for the application of paper mill sludge and gypsum.

- c. Livestock and Poultry Sector**

The increase in production of milk, meat and eggs in Odisha can partially be attributed to the state's comprehensive policy on livestock and poultry sector development. In this section, we discuss the Poultry Policy of Odisha (2015), Bovine Policy of Odisha (2015) and the New Livestock Policy of Odisha.

- 1. Poultry Policy of Odisha**

To boost the poultry sector, Odisha was one of the leading states to have declared poultry as agriculture and initiated many promotional efforts such as (1) reduction of electricity tariff for poultry farming, (2) reimbursement of VAT on maize and broken rice used for poultry feed, (3) supply of eggs in the mid-day meal scheme at primary schools (Odisha Poultry Policy, 2015).

The state government launched its poultry policy in 2015 with a specific objective to enable a conducive environment for commercial poultry farming, promote backyard poultry farming for livelihood, increase the production of eggs from 6.3 million eggs per day (2011-12) to 1.0 million eggs per day and meat from 76 thousand MT (2011-12) to 110 thousand MT broiler meat per annum by 2020, promote the creation of infrastructure like laboratories, processing units, etc., and boost processing and distribution facilities.

The poultry policy specifies the following schemes for poultry farming in Odisha:

**a) Commercial Layer Farming:**

- (i) *Expansion of existing Commercial Layer Poultry Units:* The government aims to encourage existing entrepreneurs to utilise capital investment subsidy under the state's agriculture policy 2013 to expand existing commercial layer poultry units for an additional capacity of 1.0 million over a period of 4 years.
- (ii) *Setting up new Commercial Poultry Layer Farms:* The government intends to encourage prospective entrepreneurs to set up new commercial poultry layer units for an additional capacity of 5.0 million over a period of four years by utilising the capital investment subsidy under the state's agriculture policy 2013 for establishing new units.

**b) Commercial Broiler farming**

- (i) *Expansion and Setting up of New Commercial Broiler Units:* Encourage entrepreneurs to expand and set up of new commercial broiler units with an additional capacity of 4.0 million over a period of four years to increase production of broiler meat from the present level of 70 thousand MT to 100 thousand MT per annum.
- (ii) *Value Chain Finance:* Promote tripartite agreements between farmers, integrators<sup>17</sup> and bankers.
- (iii) *Financial Assistance:* Financial assistance to be provided by commercial and co-operative banks for poultry farming to set up an additional capacity of 4.0 million broilers over a period of four years. Further, entrepreneurs will be encouraged for the establishment of the existing broiler units through capital incentive subsidy available under the Poultry Venture Capital Fund under NABARD and the state's agriculture policy 2013.

**c) Backyard Poultry Farming**

- (i) *Promote backyard poultry production through rearing of low-input-technology birds:* Low-input-technology birds can be procured from government and private hatcheries. As per the GOI's rural backyard poultry scheme guidelines, 20 chicks will be given initially, followed by 15 and 10 chicks at an interval of 16 weeks each. Each unit will get

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<sup>17</sup> Integrators supply day-old chicks, feed required for the birds and ensure the marketing of birds through their own channels

assistance for construction of night shelter for birds and for procurement of 45 four-week-old chicks

- (ii) *Disease prevention and control*: Through routine vaccination and de-worming and supply of the required quantity of vaccines against disease and proper cold chain management. Further, the policy intends to strengthen district disease diagnosis laboratories for poultry diseases.

**d) Backyard Duck Farming**

- (i) *Promote Duck-Fish Farming*: Under the state agriculture policy of 2013, capital investment subsidy is available for commercial duck farming (minimum unit size – 4000 ducks), the Government of Odisha intends to promote backyard small duck units

**e) Other benefits to Poultry Entrepreneurs**

- (i) 100 per cent stamp duty exemption allowed on purchase of land in any part of the state (maximum 10 acres for one layer unit and 6 acres for one unit of broiler parent bird)
- (ii) Exemption of conversion charges of the Orissa Land Reform Act for conversion of agricultural land to homestead land for poultry farms will be allowed
- (iii) Feed mixing plant catering to the exclusive needs of a poultry farm as a captive unit and using electricity within 20 per cent of the total contract demand of the farm will be treated as agriculture/allied activity for the purpose of electricity tariff. Government land can be given on lease basis to set up poultry units.

**2. Bovine Policy of Odisha**

The Government of Odisha issued the ‘Odisha Bovine Breeding Policy’ in 2015. The main objective of the policy is to produce economically productive milch animals in large numbers, to conserve and improve indigenous germplasm and genetic improvement of the buffalo population for increased milk production. As per the 2007 Livestock Census, the cattle population constituted around 53.4 per cent of total population and buffaloes only 5.2 per cent. The government aims to increase number of adult female population of cattle and buffaloes during the period 2015-2020, i.e., 40 per cent of the non-descript cattle, 70 per cent of cross bred cattle and 40 per cent of buffaloes.

The salient features of the bovine policy are as follows:

- Government intends to strengthen the network of artificial insemination (AI) by opening new artificial insemination centres (AIC) and converting static AICs to mobile AICs.
- To meet the need for future semen straws, the government aims to strengthen the existing frozen semen bank (FSB) infrastructure and create new FSBs. Currently, there is only one FSB in Cuttack.

- The state aims to strengthen district level semen depots to ensure smooth delivery of AI inputs to field AICs
- Based on the type of availability of nondescript animals in different localities of the state, the government will undertake a genetic up-gradation programme by introducing germplasms of Sahiwal, Gir, Tharparkar breeds in addition to the Haryana, Red Sindhi and Binjharpuri breeds.
- Further, the bovine policy states that in areas where infrastructure facilities for health care and organised marketing of milk are available, Jersey and HF breeds of cattle should be considered as breeds of choice for genetic improvement through cross breeding. For buffaloes, Murrah is considered as the breed of choice for up-gradation of local buffaloes

### 3. Livestock Policy of Odisha

Odisha was the first state to have formulated a livestock policy and its implementation started in 2003-04. Its 2002 livestock policy was formulated with specific actions for a ten-year period from 2002 to 2012. It was implemented in two phases, each of five years: Phase I from 2002 to 2007 and Phase II from 2007 to 2012.<sup>18</sup> The main focus of the policy was to improve the input delivery system and the quality of inputs; increase adoption of modern technology and improved breeds, restructure artificial insemination management, increase access to credit and control of animal diseases. The salient features of the policy are given below.

- (i) **Redesign the Input Delivery System:** Provide free animal health care and breeding services to livestock producers by the government. Currently, animal health care is being provided through a network of 540 veterinary hospitals and dispensaries with 682 veterinary doctors and 2,939 livestock aid centres (LAC) with 2,467 livestock inspectors and 682 veterinary doctors
- (ii) **Improve the Quality of Input Services:** To improve the quality of services, the government intends to progressively make information on veterinary and artificial insemination services mobile based and deliver services to farmers at their door-step, as paid inputs. These reforms will be implemented in a phased manner; first in well developed areas, which can absorb the change and work it to their advantage. Currently, there are 53 mobile veterinary units operational in the tribal dominated blocks of the state.
- (iii) **Adoption of Modern Technology and Breeding:** Enhance productivity by integrating highly productive modern technology and management into Odisha's traditional system. Introduction of high yielding variety of breeds with improved body size and body weight for producing good work animals as well as a good foundation stock for cross breeding. Currently, there are eight breeding farms in the state. These farms produce high pedigree bull calves to improve breeding and productivity of local animals through natural services/artificial Insemination. The farms also produce and supply fodder and root slips to local farmers and propagate fodder cultivation programmes

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<sup>18</sup> <http://odishaahvs.com/common/perspective-plan.htm>

- (i) **Training and Skill Development:** There are several tasks in livestock rearing that do not require trained veterinary or livestock inspectors such as veterinary first aid, vaccination of birds and animals, ecto and endo parasite control, innovative feed supplementing techniques, shelter innovations and candling of desi eggs for hatching. Small holder households can be trained in the village to practice these skills
- (ii) **Develop grass root level participatory bodies to link producers with animal husbandry department:** In order to reach out to each and every individual household to disseminate information, develop skills and understand the needs of small producers, the state is working towards forming grass root level community participatory bodies such as producer co-operatives, breeders' associations, self-help groups, farmer producer organisations and voluntary organisations
- (iii) **Restructuring artificial insemination management in Odisha:** The new livestock policy introduced the restructuring of the management of the AI system by establishing the Orissa Livestock Resources Development Society. The new livestock sector policy, therefore, transferred the task of generating high quality AI inputs like genetically evaluated AI bulls, frozen semen and liquid nitrogen and their supply to all AI practitioners, to this new organisation. Currently, AI is being rendered through a network of 5,826 departmental AI centres. AI programmes in Odisha increased from 0.7 million in 2005-06 to 1.4 million in 2013-14
- (iv) **Access to credit:** In order to promote intermediate production system, government mobilised credit through commercial banks for mini dairy schemes, small animals and poultry schemes. A subsidy package similar to the Government of India's scheme, "Special Livestock Breeding Programme" (SLBP), was introduced, along with a concessional credit scheme for the bottom end of the small holder spectrum. Currently, the government provides short term credit for dairy farming at subsidised rate of interest of 5 per cent and an additional 3 per cent interest subvention is made available for prompt repayment of instalments in due time. Long-term credit for dairy farmers is available for purchase of equipment, machinery, shed, procurement of livestock and other activities at an interest rate of 3 per cent. Further, an additional 2 per cent interest subvention is provided for prompt repayment of instalments in due time
- (v) **Disease control and eradication:** The new livestock policy proposed the launch of a state-wide FMD control programme as part of a national control programme.

#### **4. Benefits under Odisha State Agriculture Policy-2013 (OSAP)**

In order to boost milk processing in Odisha (OSAP) provides 50 per cent subsidy on milk machines (maximum of Rs.25,000), manual/power operated chaff cutter (maximum of Rs.12,000), cream separator (maximum of Rs.50,000), mini cattle/poultry mills (maximum of Rs.1,50,000), paneer making machine (maximum of Rs.1,00,000), deep freezer (maximum of Rs.500,000) and bulk cooler and chillers (maximum of Rs.500,000)

### Annexure III: Discrepancy in Road Data

  
सत्यमेव जयते

**KIRTI SAXENA**  
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Dated : 02.12.2016

Dear *Shri Hussain,*

Please refer to your e-mail dated 8<sup>th</sup> November 2016 addressed to Secretary, Ministry of Road Transport and Highways requesting for clarification in respect of road length data of Odisha State.

2. I understand that the Director (R/RT) TRW Shri Ranjan Mukherjee has discussed the above issue with you.
3. The Government of Odisha had reported 1,71,070 km road length as on 31.3.2011 under Zilla Parishad and Panchayat Samiti road, without providing the category wise details i.e. surfaced and un surfaced road length. As the information was received late, the data could not be incorporated in the Basic Road Statistics of India 2010-11.
4. Since the Government of Odisha did not provide data on Panchayati Raj roads in the subsequent years, the figure of 1,71,070 km was repeated in the Basic Road Statistics of India 2011-12, 2012-13, 2013-14 & 2014-15. In absence of the surfaced and un-surfaced break-up, it got inadvertently incorporated in the surfaced category of road in the 2012-13, 2013-14 & 2014-15 issues of Basic Road Statistics of India. Hence, the sudden increase in the share of surfaced road in the total road length in respect of Odisha from 2012-13.
5. The discrepancy pointed out has been taken up with the State Government for necessary reconciliation. Reconciled information will be intimated once the State Government report it to us.

Yours Sincerely,  
*Kirti Saxena*  
(Kirti Saxena)

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