# Research Report on
# Factor Productivity and Marketed surplus of Major Crops in India

## Analysis of Orissa State

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**BY**

**A.Amarender Reddy**

**ADMINISTRATIVE STAFF COLLEGE OF INDIA**
BELLA VISTA: HYDERABAD - 500 082

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**A.Amarender Reddy**

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# Abstract

*Over the last three decades there has been stagnation in agriculture in Orissa. During the period 1996 to 2003 the growth rate is negative in area, production and yield in major crops. The study estimated TFP growth of major crops in Orissa from 1971 to 2003 at state level. The study also estimated district level production efficiency by using frontier production function for the period 1971 to 2005 by using district level data on inputs and outputs. The marketed surplus of major crops has been estimated by using primary survey data for the period 2007 by using modified Raj Krishna model.*

*Study indicates the TFP growth of all crops, except paddy, groundnut and jute has been declined with negative growth. Concentration of cropped area is increased towards paddy cultivation. There is a significant increase in real cost of production and relative decline in price of output for all major crops, with consequent adverse effects on gross cropped area. There is an urgent need to increase TFP growth in all crops especially in pulses and oilseeds to make their cultivation profitable and to increase crop diversification and optimal utilization of land and water resources. For achieving the desired level of food production keeping in mind the dietary requirement, we need to raise GCA and cropping intensity, which, in turn, depends on increase in crop diversification towards pulses and oilseeds, irrigation facilities and infrastructure. The results also pointed out significant monetary benefits to farmers through crop diversification to pulses and oilseeds from the existing cropping pattern, in addition to gains in food security at macro-level*

*To sustain the agricultural production, we need enhanced supply of inputs like seed, fertilizer and pesticides and irrigated area. Seed replacement ratio is less than 20% for most of the crops, which needs to be increased by supply of certified seed. Total seed supplied for all crops in 2005-06 is 62, 000 tonnes, projected demand for seed is 72, 568 tonnes for 2011-12. Likewise fertilizer consumption per ha. of GCA was 70 kg for year 2005-06, projected to increase further to 134 kg for the year 2011-12. Infrastructure items such as farm energy and power and, agricultural credit need to be developed concurrently to sustain agricultural growth at desired level.*

*Literate rate, % agricultural workers, irrigation, electricity used for agricultural purpose, marketing infrastructure and transport facilities are crucial for increasing agricultural value from districts. Steps to be taken to improve conditions in the above aspects. Efficiency level at district level is very low with only 36%. Which indicates that with the existing resources and technology districts agricultural value product can be increased by 64%.*

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## Chapter-I

## Introduction

In the liberalized era, improving productivity, competitiveness and increasing marketed surplus are important goals of agriculture sector. To achieve the above goals is important especially for underdeveloped states like Orissa, which is characterized by low productivity, low investment and low crop income for a long time. Identifying price and non-price factors in a specific geographical setup for accelerating the growth in agriculture sector is critical to remove bottlenecks for overall development of the state. In the background of increasing need for food security along with market driven policies, one needs reliable empirical knowledge about the degree of responsiveness of demand and supply for factors and products to relative prices, technological change and other institutional factors. Studies in the factor productivity with special emphasis on regions/districts in Orissa will help in characterizing the districts according to productivity growth of different crops and will facilitate the planners to focus on potentially high productivity growth areas for increasing area and productivity under different crops. By simultaneously studying the factor share and output supply of major crops we can suggest policy options for different farmer groups/agro-ecosystems based on their factor endowment to increase output supply and marketed surplus. The outcome of these adjustments in factors/outputs will be linked to marketed surplus for optimum allocation of factors of production to increase marketed surplus of major crops.

In Orissa trends in area, production and productivity are very low upto 2003 for both food grains and oilseeds. Then after agricultural productivity has been increased for all the crops. Hence this study focuses on the causes for contraction of area and production and TFP growth of major crops up to 2003. No single study exists for Orissa both at the state level and also district level. Hence this study proposed to study Total factor Productivity growth and efficiency in orissa agriculture with the following main objectives. (i) How the total factor productivity (TFP) index is changing over time for principal crops at state level? (ii) How the changes in factor share are taken place? (iii) How the real factor and product prices have changed for different crops in Orissa? (iii) What is the extent of the inter-district differences in productive efficiency? (iv) What are the factors, which influence the differences in agricultural production, and (V) extent of marketed surplus of major crops and its determinants?

**Objectives**

(1) To examine the behavior of input-output prices, factor shares, technological and institutional factors and total factor productivity of major crops in Orissa.
(2) To estimate the output supply elasticities with respect to change in inputs
(3) To compute the marketed surplus elasticities with respect to product price, technology and other institutional factors.
(4) To measure the effect of price and non-price factors on output supply and marketed surplus, and its policy implication towards food security.

**Review of Literature**

There are very few studies existing in measuring the factor shares, output supply and marketed surplus simultaneously and also interlinking them with price and non-price factors (like credit, technology, irrigation etc.) and studying them in integrated way will be essential to make any policy options for increasing output supply and marketed surplus of crops. There are studies for Punjab, Western India, Tamil Nadu, but for Orissa there is no detailed scientific and exploratory study exists. At national level also many studies concentrated on studying rice and wheat, but little work has been done on other crops (pulses and oilseed crops) with the above objectives (Chand, 1986).

Ramesh Chand (1986) examined the effect of input and output prices on input demand for major crops of Punjab. Quadratic profit function was used to estimate the factor demand equations. The results revealed that the elasticities of factor demand with respect to output prices were positive in all cases except for labour demand function in cotton and gram and bullock labour demand function in gram. Fertilizer was found to be weak complement of human labour in wheat and gram but a strong substitute in case of paddy. Further, it was observed that the input-output price structure followed in the past, has decreased the demand for factors in crop production except for fertilizer. The study concluded that if the past structure of input-output price was maintained in future, without technological change, it would decrease the demand for human as well as bullock labour.

Mittal (2001) conducted a study entitled " Productivity and Source of Growth for Wheat in India". The result of the study shows that TFP index for wheat has risen at the rate of 0.9 percent per annum and has contributed 24% to output growth. TFP growth has lowered the unit cost of production and wheat price benefiting both producer and consumer.

Research investment, quality of input and rural infrastructure are the most important determinants of output growth.

In marketed surplus studies, Janvry and Kumar (1981) formulated a model for the analysis of marketed surplus response to output and factor price changes. They also studied the implication of each prices on farmers' income. The estimates of factor demand and output supply elasticities, were computed from jointly estimated output supply and factor demand equations and used to calculate the elaticities of marketed surplus. The elasticities of marketed surplus with respect to wage rate and fertilizer price were-0.19 and –0.24 respectively on small and –0.10 and –0.23 on large farms. The response to output price was observed to be negative (-0.23) on small farms and positive (0.26) on large farms. On small farms the negative response resulted from the dominance of income effect in consumption, which had negative effect on marketed surplus. In contrast for large farm the income effect was small and the positive output response to higher wheat prices dominated the adjustments in marketed surplus. Kumar and Dey (2004) used a multi-stage budgeting framework in estimating the demand function for disaggregated commodity groups based on Almost Ideal Demand System. The model has been adopted for fisheries demand in India. Own-price elasticity of demand for fish is high and has not shown any sign of decline during the last 15 years. These elasticities are substantially higher in eastern, northeastern and southern states.

Among international studies, Huang (1998) conducted study entitled "Investigation of cost function of the small abalone farms in Taiwan". The translog cost model is used to study price elasticity of factor demand output elasticity of small abalone farms in Taiwan. An output elasticity of 0.89 reveals decreasing return to scale in production. Luh (1993) conducted a study entitled "Are Farmers Learning by Doing? Experience in Taiwan? The results indicated long lags in adjustment of both agricultural labour and capital, and also suggest that asset fixity is an important characteristic of Taiwan Agriculture. This study demonstrated that labour using and capital saving were characteristics of technical change in Taiwan agricultural production during past two decades. An earlier study indicated that technical change is consistently biased against labour but towards capital and intermediate input for U.S. Agricultural production. This pattern of factor bias illustrated the possibility of influence of resource endowments on technological change.

## Chapter-II

## Orissa Agricultural Economy: Interstate Comparison

Over the last three decades there has been stagnation in agriculture in Orissa. From early 1970s to late 1990s the growth rates in area under food grains, yield rate and production are found to be 0.54, 1.34 and 1.88 respectively. During the period 1996 to 2005 the growth rate in food grain production is 2.52%. These growth rates particularly from 1970s to early 1990s are much lower in comparison to other Indian states and all-India average. The year wise area, yield and production of food grains, pulses and oilseeds have been indicated for the period 1996-2006 in Table 2.1. It shows that in production of oilseeds Orissa recorded a negative growth rate, while in production of food grains it recorded significant positive growth, mainly because of increase in area under food grains, especially paddy crop. It also indicates that, during the last decade there is an increase in concentration in Orissa agrarian economy in recent years towards paddy with significant decline in area under oilseed crops.

The yield rate of food grains in Orissa was only 1348.7 kg/ha, whereas for all-India the figure was quite higher i.e. 1715.7 kg/ha. Also, in the neighboring states of West Bengal and Andhra Pradesh having similar agro-climatic conditions, the yield was substantially higher i.e.2332 kg/ha and 2120 kg/ha respectively (Table 2.2). Orissa food grain yields were almost equivalent to agriculturally less developed and drought prone states like MP (1177 kg/ha), Rajastan (1018 kg/ha) and Maharastra (1028 kg/ha). If we consider the yield rate of rice, which is the staple cereal crop of Orissa, the picture is, also, not encouraging. The average per hectare yield rate of rice in Orissa is only 1348 kg, whereas the all-India average is 2046 kg. The main reason for low yield of food grains in Orissa is due to a low level of commercialization of agricultural sector, both input and output side. For example fertilizer, pesticide and credit use per ha in Orissa is one of the lowest in India. The Gross Irrigated Area (GIA) as percent of total cropped area is just 28% as against national average of 38.7%, even though there is vast scope to increase unexplored irrigation potential. As a result of all these factors, agricultural GDP per hectare is just Rs.11, 839.5/- as against Rs. 39,872/- in case of West Bengal, Rs.21,443/- per ha in case of Andhra Pradesh in 2006.

**Table 2.1 Trends in Area, Production and Yield of Major Crops in Orissa and India**

| | Food Grains | | Pulses | | Oilseeds | |
|---|---|---|---|---|---|---|
| Year | Orissa | All India | Orissa | All India | Orissa | India |
| Area (000 ha) | | | | | | |
| 1996 | 5351.1 | 123581.4 | 658.8 | 22447.1 | 406.2 | 26338.1 |
| 1997 | 5481.8 | 123846.9 | 786.2 | 22871.2 | 423.4 | 26123.6 |
| 1998 | 5367.9 | 125167.1 | 721.9 | 23500.7 | 378.6 | 26228.8 |
| 1999 | 5487.7 | 123104.0 | 684.0 | 21116.2 | 342.5 | 24282.4 |
| 2000 | 5245.4 | 121048.3 | 604.3 | 20348.3 | 277.3 | 22770 |
| 2001 | 5407.2 | 122779.6 | 713.7 | 22008.4 | 325.7 | 22636.4 |
| 2002 | 4991.7 | 113860.0 | 548.7 | 20496.2 | 265.8 | 21488.8 |
| 2003 | 5388.1 | 123446.5 | 714.8 | 23458.1 | 304.5 | 23662.9 |
| 2004 | 5299.7 | 120078.0 | 642.5 | 22763.0 | 316.0 | 27523.3 |
| 2005 | 5456.7 | 121569.4 | 809.2 | 22361.1 | 332.0 | 27862.8 |
| CAGR(%) | -0.18 | -0.40 | -0.06 | -0.05 | -3.36 | -0.01 |
| Production (000 ha) | | | | | | |
| 1996 | 4831.4 | 199435.7 | 225.9 | 14243.9 | 167.4 | 24384.5 |
| 1997 | 6637.8 | 192258.7 | 286.5 | 12979.3 | 191.2 | 21324.7 |
| 1998 | 5793.1 | 203606.9 | 249.3 | 14907.3 | 160.6 | 24748.2 |
| 1999 | 5622.5 | 209801.5 | 264.8 | 13418.3 | 160.8 | 20715.5 |
| 2000 | 4984.2 | 196814.1 | 212.7 | 11075.6 | 117.9 | 18436.8 |
| 2001 | 7564.1 | 212851.2 | 284.2 | 13368.1 | 137.5 | 20662.4 |
| 2002 | 3573.7 | 174771.4 | 194.4 | 11125.0 | 93.7 | 14838.4 |
| 2003 | 7156.9 | 213189.4 | 272.7 | 14905.2 | 156.9 | 25186.1 |
| 2004 | 6889.7 | 198362.8 | 249.6 | 13129.5 | 179.5 | 24353.5 |
| 2005 | 7359.7 | 208577.1 | 336.3 | 13359.9 | 187.7 | 27977.9 |
| CAGR(%) | 2.52 | 0.23 | 1.47 | -0.53 | -0.60 | 0.83 |
| Yield (kg/ha) | | | | | | |
| 1996 | 902.9 | 1613.8 | 342.9 | 634.6 | 412.1 | 925.8261 |
| 1997 | 1210.9 | 1552.4 | 364.4 | 567.5 | 451.6 | 816.3002 |
| 1998 | 1079.2 | 1626.7 | 345.3 | 634.3 | 424.2 | 943.5506 |
| 1999 | 1024.6 | 1704.3 | 387.1 | 635.5 | 469.5 | 853.1076 |
| 2000 | 950.2 | 1625.9 | 352.0 | 544.3 | 425.2 | 809.697 |
| 2001 | 1398.9 | 1733.6 | 398.2 | 607.4 | 422.2 | 912.7953 |
| 2002 | 715.9 | 1535.0 | 354.3 | 542.8 | 352.5 | 690.5179 |
| 2003 | 1328.3 | 1727.0 | 381.5 | 635.4 | 515.3 | 1064.371 |
| 2004 | 1300.0 | 1651.9 | 388.5 | 576.8 | 568.0 | 884.8321 |
| 2005 | 1348.7 | 1715.7 | 415.6 | 597.5 | 565.4 | 1004.131 |
| CAGR(%) | 2.70 | 0.63 | 1.54 | -0.47 | 2.76 | 0.84 |

Source: Authors calculations from Orissa Statistics Year Book, 2007

In Orissa, food grains account for a major proportion of gross cropped area (Table 2.3). The percentage of gross cropped area under food grains was 84.9 per cent in 1971, it increased to a peak of 89.4% in 2001, and once again it reduced to 77.0 per cent in 2008. Thus, only 23 per cent of the gross cropped area was under cash crops, which

include oilseeds, fibre crops, plantation crops and vegetables. There has not been any perceptible change in the cropping pattern during the period 1971-2006. Instead of diversification in cropping pattern favouring cultivation of more remunerative cash crops, percentage area under food grains has slightly increased from 84.9 per cent in 1971 to 89.4 per cent in 2001 and then after decreased 77% in 2008. Regarding intensity of cropping, Orissa is far behind achieving double cropping. Cropping intensity, which was 146 per cent in 1985, has actually declined to 139 per cent in 2001 but again increased to 158 per cent in 2008. Area under paddy decreased from 66.1 % of Gross Cropped Area (GCA) in 1970-71 to 45.9% of GCA in 1991 and then again increased to 74.4 per cent in 2001, and later it declined to 50% in 2008. It once again shows that, until 2001, there is a concentration of area under paddy, however crop diversification taken place then after due to expansion of area under pulses, vegetables and spices. Area under pulses decreased from 12.5% in 1971 to 11.8 per cent and again increased to 22.0 per cent. Area under oilseeds shows higher level of fluctuations, as it increased from 4.9 per of GCA in 1971 to 12.4% of GCA in 1991 and once again declined to 6.4% of GCA in 2000 and it is 9% of GCA in 2007.

As a result of stagnant or declining agricultural sector since 1970s, and also less commercialization of all economic activities Orissa economy is stagnant when compared to growth seen in other states and also India. For example in 1981, per capita SGDP of Orissa is about 76% of national per capita GDP, while it decreased to 62% in 2001 and again decreased to 53.5%. It is one of the lowest in the country.

| Table 2.2. Inter-state comparison of Indicators of Agricultural Development TE 2006 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **State** | Yield Rate Food Grains (Kg/ha) | Yield Rate of Rice (Kg/ha) | % of GCA Irrigated | Fertilizer Use (kg/ha) | Average Size of Operational Holdings (ha) | Poverty (%) | Credit-Deposit Ratio | NSA (000 ha) | Bank Branches/ 1000 ha | NSA (ha/capita) | Agril. GDP (Rs.1000/ha) |
| **I. Eastern Region** | | | | | | | | | | | |
| **Orissa** | 1348 | 1348 | **27.5** | **43.8** | **1.34** | **48** | 39.8 | 5739 | 3.9 | 0.156 | 11839.5 |
| Bihar | 1526 | 1378 | 46 | 97.2 | 0.93 | 44 | 22.5 | 5572 | 9 | 0.067 | 24102.8 |
| West Bengal | 2332 | 2396 | 27.5 | 136 | 0.9 | 31.9 | 45.2 | 5295 | 8.3 | 0.066 | 39872.2 |
| **II. Southern Region** | | | | | | | | | | | |
| Andhra Pradesh | 2120 | 2947 | 43.1 | 155.5 | 1.56 | 11.1 | 63.8 | 10745 | 4.7 | 0.141 | 21443.5 |
| Karnataka | 1431 | 2682 | 23.7 | 103.1 | 2.13 | 17.4 | 61 | 10509 | 4.5 | 0.199 | 13864.5 |
| Kerala | 1876 | 2003 | 15.4 | 70 | 0.33 | 9.4 | 42.3 | 2132 | 15.2 | 0.067 | 26403.5 |
| Tamil Nadu | 2417 | 3646 | 51.8 | 162.9 | 0.93 | 20.6 | 88 | 5244 | 9 | 0.084 | 23889 |
| **III. Central Region** | | | | | | | | | | | |
| Madhya Pradesh | 1177 | 1071 | 25.8 | 47.2 | 2.63 | 37.1 | 49.2 | 14971 | 3 | 0.248 | 10880.8 |
| Gujarat | 1516 | 1728 | 33.1 | 87.8 | 2.93 | 13.2 | 49.8 | 9852 | 3.7 | 0.194 | 16833.1 |
| Rajasthan | 1018 | 1293 | 32.6 | 39.5 | 4.11 | 13.7 | 46.7 | 16836 | 2 | 0.298 | 9837.3 |
| Maharashtra | 1028 | 1760 | 14.5 | 88.9 | 2.2 | 23.7 | 83.8 | 17473 | 3.6 | 0.18 | 12081.8 |
| **IV. North-Western Region** | | | | | | | | | | | |
| Utter Pradesh | 2078 | 2078 | 66.9 | 125.4 | 0.89 | 31.2 | 27.5 | 16683 | 5.3 | 0.1 | 23305.8 |
| Punjab | 3964 | 3339 | 94.1 | 184.6 | 3.61 | 6.4 | 39.1 | 4243 | 5.9 | 0.174 | 41533.9 |
| Haryana | 2862 | 2374 | 78.8 | 148.5 | 2.43 | 8.3 | 41.4 | 3566 | 4.2 | 0.169 | 33740.7 |
| India | 1717 | 2046 | 38.7 | 95.3 | 1.57 | | | | | | |

**Source: Annual Statistical Abstracts of Various States**

**Table 2.3. Trends in Cropping Pattern since 1971**

| S. No. | Principal Crop | 1970-71 | 1980-81 | 1990-91 | 2000-1 | 2007-08 |
|---|---|---|---|---|---|---|
| 1. | Paddy | 66.1 | 47.9 | 45.9 | 74.4 | 50.0 |
| 2. | Total Cereals | 72.4 | 59.3 | 51.7 | 77.6 | 55.0 |
| 3. | Total Pulses | 12.5 | 19.7 | 22.2 | 11.8 | 22.0 |
| 4. | Total Food grains | 84.9 | 79.0 | 73.9 | 89.4 | 77.0 |
| 5. | Total Oil Seeds | 4.9 | 8.4 | 12.1 | 6.4 | 9.0 |
| 6. | Total Fibres | 1.2 | 1.1 | 0.9 | 1.2 | 1.0 |
| 7. | Other Crops (veg. & spices) | 8.1 | 10.6 | 12.4 | 3.0 | 13.0 |
| | All Crops | 100 | 100 | 100 | 100 | 100 |
| | Total Area (000 ha) | 5601 | 6130 | 6304 | 5980 | 8960 |
| | Cropping Intensity (%) | 133 | 135 | 141 | 139 | 158 |

Source: Government of Orissa, *Economic Survey*, various Issues, Directorate of Economics and Statistics, Bhubaneswar,

**Table 2.4. Per capita GSDP as a percent of GDP**

(Three-year average of incomes at current prices centered on)

| States | 1981 | 1985 | 1991 | 2001 | 2006 |
|---|---|---|---|---|---|
| Eastern Region | | | | | |
| Orissa | 75.7 | 74.7 | 66.9 | 61.8 | 53.5 |
| Bihar | 58.8 | 60.6 | 53.5 | 44.2 | 109.0 |
| West Bengal | 103.3 | 102.9 | 91.7 | 85.1 | - |
| II. Southern Region | | | | | |
| Andhra Pradesh | 87.4 | 82.4 | 92.5 | 92.9 | 97.0 |
| Karnataka | 92.8 | 93.7 | 95.4 | 107.2 | 62.7 |
| Kerala | 90.5 | 90.9 | 87.8 | 116.4 | 119.4 |
| Tamil Nadu | 92.8 | 97 | 100 | 119.5 | 108.0 |
| III. Central Region | | | | | |
| Madhya Pradesh | 80.8 | 74.8 | 78.1 | 73.5 | 49.2 |
| Gujarat | 125.3 | 124.4 | 118.8 | 137.4 | 76.1 |
| Rajasthan | 76.6 | 74 | 79.3 | 81.1 | 44.5 |
| Maharashtra | 143 | 134.7 | 144.7 | 167.5 | 54.6 |
| IV. North-Western Region | | | | | |
| Uttar Pradesh | 75.8 | 71.9 | 70.6 | 64.4 | 105.4 |
| Punjab | 168.6 | 165 | 169.7 | 146.5 | 187.8 |
| Haryana | 146.5 | 139.9 | 146.6 | 139.4 | 152.6 |
| All India | 100 | 100 | 100 | 100 | 100.0 |

**Source: Annual Statistical Abstracts of various states**

## Chapter-III
## Agricultural Production Scenario in Orissa

**A**griculture is the mainstay of State's economy and substance of life for the people. The State Orissa is an agrarian state with Agriculture and Animal Husbandry Sector contributing more than 22.5 % to the Net State Domestic Product (NSDP) in 2006-07 at 1999-2000 prices and 26.4% in current prices (2004-05) providing employment, directly or indirectly to 65.0% of the total work force. Nearly 85 per cent of total population live in rural areas most of them directly or indirectly dependent on agriculture (Table 3.1). Even though percent of agricultural workers declined from 24.2% of total population in 1971 to 14.9% in 2001, in absolute terms number of agricultural workers remains same at 0.53 crores. This implies that there is stagnation in labour productivity in the agricultural sector since 1970s. The per capita availability of cultivated land, which was 0.39 ha in 1950, has been drastically reduced to 0.16 ha in 2006, as productivity per land is not showing any perceptible increase; productivity per farm household is decreased in real terms.

**Table 3.1: Population statistics**

(Figures in crores)

| | **1971** | **1981** | **1991** | **2001** |
|---|---|---|---|---|
| Population | 2.19 | 2.64 | 3.17 | 3.68 |
| Rural | 2.01(91.8) | 2.33(88.3) | 2.75(86.8) | 3.13(85.1) |
| Urban | 0.18(8.2) | 0.31(11.7) | 0.42(13.2) | 0.55(14.9) |
| Agricultural workers | 0.53(24.2) | 0.64(24.2) | 0.76(24.0) | 0.55(14.9) |
| Cultivators | 0.34(64.2) | 0.4(62.5) | 0.46(60.5) | 0.34(61.8) |
| Agril. Labourers | 0.19(35.8) | 0.24(37.5) | 0.3(39.5) | 0.21(38.2) |
| Decennial Population Growth Rate | 25.1 | 20.2 | 20.1 | 16.25 |

**Source: Census of India, different volumes**

**Land use in Orissa**

The total geographical area of the state is 155.7 lakh ha, out of which 37.3 per cent is forestland and 41.5 per cent area is suitable for cultivation and 36.12 per cent of area (61.8 lakh ha) is cropped area. Gross cropped area is 90.09 lakh ha, with a cropping intensity of 160% in the year 2007. Gross irrigated area is 33.08 lakh ha (36% of GCA). The ground water development in Orissa is at very low level of development. The level of ground water development is expressed as the ratio of Net Yearly Draft to Utilisable Ground Water Resource for Irrigation multiplied by hundred. The stage of ground water development for the state as whole is also very low i.e. 8.4 per cent compared to 98.2 per cent for Punjab and 80.2 per cent for Haryana and all India average of 30.1 per

cent. Out of 61.8 lakh ha cultivated area 29.14 lakh ha is high land, 17.55 lakh ha medium land and 15.11 lakh ha low land. The main food staple crop is Paddy. The Paddy area during Kharif is about 41.18 lakhs & during Rabi 3.29 lakh ha. The land use statistics of the State is indicated below.

**Table 3.2 Land and Resource Use Statistics in Orissa (2007-08)**

| | | Area in Lakh ha |
|---|---|---|
| 1 | Forest | 58.13 (37.33) |
| 2 | Miscellaneous Trees & Groves | 3.42 (2.20) |
| 3 | Permanent Pasture | 4.94 (3.17) |
| 4 | Culturable waste | 3.75 (2.41) |
| 5 | Land put to non-agriculture | 12.98 (8.34) |
| 6 | Barren & un-cultivable land | 8.40 (5.39) |
| 7 | Current fallow | 5.56 (3.57) |
| 8. | Other fallow | 2.29 (1.47) |
| 9 | Net Sown Area | 61.8 (36.12) |
| 10 | Total Geographical Area | 155.71 (100) |
| 11 | Gross cropped area | 90.09 |
| 12 | Cropping Intensity (%) | 160 |
| 13 | Gross Irrigated Area (%) | 33.08 |
| 14 | Fertilizer Consumption (kg/ha) | 53.2 |
| 15 | Pesticide Consumption (gm a.i./ha) | 143.08 |
| 16 | Share of power consumption for agriculture (%) | 1.4 |
| 17 | Farm power input (KWH/ha) | 0.88 |
| 18 | Crop loan (Rs./ ha NSA) | 3971.3 |

Source: Orissa: Agriculture at a glance, 2007-8

**Soil and Topography**

The State is broadly divided in to 4 physiographical zones namely, Coastal Plains, Central Tableland, Northern Plateau and Eastern Ghats. The State has different soil types ranging from fertile alluvial deltaic soils in the coastal plains, mixed red and black soils in central tableland, red and yellow soils with low fertility in the Northern Plateau to red, black & brown forest soils in Eastern Ghat region. The soil types differ widely from

highly acidic to slightly alkaline and from light sandy to stiff clays. The soils are mainly acidic with the degree of acidity varying widely. Further about 4 lakh ha are exposed to saline inundation, 3.54 lakh ha to flooding and 0.75 lakh ha to water logging, particularly in the deltaic areas.

**Status in modern input use**

Table 3.2 depicts land and input use in agricultural sector. Use of modern inputs like fertilizer (53.2 kg/ha) and pesticide (143.1 gm a.i./ha) is much less when compared to all India. Share of power consumption by agricultural sector is just about 1.4% of total power consumption, which is hovering around 20 to 25% for most of the states. Farm power input per ha is also very low with 0.88 KWH/ha. The above figures indicate that Orissa agriculture is generally low-input low-output cycle. The most important indicator of agricultural modernization is seed replacement ratio (SRR), which is percent of area covered under certified/improved seed for each crop. It is comfortably high for wheat 25%, gram (20%), groundnut (22%), sunflower (19%) and jute (46.5%), while for major staple crop paddy and oilseed crop mustard it is 12 per cent, for pulse crops like mung, urd and arhar it is less than 2% (Table 3.3). The low SRR in major staple crop paddy and pulse crops need to be addressed with wide network of seed production and distribution centers.

**Table 3.3 Seed Replacement Rate (%) for the year 2007-8**

| | Seed replacement Rate (%) | | |
|---|---|---|---|
| | Kharif | Rabi | Total |
| Paddy | 11.25 | 21.83 | 12.04 |
| Maize | 2.01 | 3.0 | 2.05 |
| Wheat | | 25.85 | 25.85 |
| Mung | 1.2 | 1.43 | 1.36 |
| Urd | 1.07 | 1.98 | 1.57 |
| Gram | | 20.46 | 20.46 |
| Arhar | 1.98 | | 1.98 |
| Groundnut | 29.89 | 22.19 | 22.19 |
| Mustard | | 12.2 | 12.2 |
| Sunflower | 100 | 10.83 | 19.09 |
| Jute | 46.47 | | 46.47 |
| Cotton | 1.75 | | 1.75 |

Source: Ministry of Agriculture, Govt. of India

**Agrarian Structure**

Though several factors are attributed for lower agricultural productivity in Orissa, many consider skewed distribution of agricultural land, small size of operational holding as major impediments to agricultural growth. An analysis of trends in the number of operational holdings and area operated reveals that the number of operational holdings in Orissa has increased substantially from about 30.0 lakh in 1961 to 45.0 lakh in 2001(Statistical Abstract, Orissa 2007). During the same period the total operational area has increased from 43.0 lakh ha to only 49.8 lakh. Thus within a span of forty years there has been 50 per cent increase in number of operational holdings which far exceeds the 15.8 percentage increase in operated area. As a result the average area operated per household has decreased from 1.44 ha in 1961 to 1.10 ha in 2001 showing 30 per cent decline.

The size-wise distribution of operational holdings and area operated (Table 3.4) shows that in the year 2004-5, 83.82 per cent of farm operators belonged to marginal farmer and small farmer categories cultivating less than 2 hectares of land together operate only 52 per cent of total operational area. On the other hand, the large farmers (operating land area more than 4 hectares) constituting only 4 per cent of total holdings cultivated a substantial proportion i.e. 20 per cent of operated area. Thus, in Orissa there is skewed distribution of land area with its concentration in a few hands of big farmers. However, percentage of area operated by large farmers shows a declining trend during the period 1961 to 2005. Moreover, the holdings are fragmented and scattered. Consolidation of holdings has been completed only in some major irrigation commands.

**Table 3.4. Distribution of Operational Holdings and Area Operated by Size Class of Land Holdings in Rural Orissa.**

| Size Class of Operational Holdings (Ha) | % of Operational Holdings | | | | | % of Operated Area | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1961 | 1971 | 1981 | 1991 | 2004 | 1961 | 1971 | 1981 | 1991 | 2004 |
| Less than 1.01 | 39.42 | 54.52 | 54.45 | 59.99 | 56.43 | 6.97 | 18.6 | 17.02 | 22.09 | 22.73 |
| 1.01-2.00 | 22.92 | 25.78 | 26.11 | 24.34 | 27.39 | 12.51 | 27.32 | 26.48 | 30.16 | 30.39 |
| 2.01-4.00 | 19.65 | 13.9 | 14.08 | 12.02 | 12.29 | 20.73 | 27.06 | 26.16 | 27.87 | 26.45 |
| 4.01-10.00 | 13.66 | 5.25 | 4.63 | 3.36 | 3.57 | 31.04 | 21.56 | 17.84 | 16.2 | 16.08 |
| Above 10.00 | 4.35 | 0.55 | 0.73 | 0.29 | 0.32 | 28.75 | 5.46 | 12.5 | 3.68 | 4.35 |
| All Sizes | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Source: various reports of NSSO and agricultural census

An inter-state comparison of size of operational holdings shows that during 2001 it was only 1.10 ha for Orissa whereas it was quite large for agriculturally advanced states like Punjab (3.31 ha) and Haryana (2.23 ha). It is not only the size of land holding is small in Orissa, but also most of the farmers are ultra-poor and are nearly resource-less. The percentage of rural population below poverty line in Orissa is extremely high (49.7%). Due to the poor resource base, the farmers in Orissa are not in a position to invest in costly inputs like chemical fertilizer, High Yielding Varieties of seeds, mechanized farm implements, pump sets etc.

## Chapter-IV

## Methodology

Increased use of inputs, to a certain extent, allows agricultural sector to move up along the production surface by increasing yield per unit area. Their use may also induce an upward shift in production function to the extent that a technological change is embodied in them. It has long been recognized that partial productivity measures, such as output per unit of individual inputs, are of limited use as indicators of real productivity change as defined by a shift in a production function. The Total Factor Productivity (TFP) concept, which implies as index of output per unit of total factor input, measures properly these shifts or increases in output, holding all inputs constant. Since the publication of Solows paper in 1957, voluminous literature dealing with the measurement and analysis of productivity at different levels of aggregation has appeared (Krishna, 1962). Until recently much of it related mainly to developed countries. However, during last two decades or so quite a few studies on agricultural productivity have also been brought out for India (Kumar and Mruthyunjaya 1992; Kumar and Rosegrant 1994). Most studies concentrated either TFP growth for each crop at state level or TFP growth at regional level. That too most of the studies carried out for developed states like Punjab, Haryana and indo-gangatic plains.

**Measurement of TFP**

The relative sect oral growth rates of productivity are important determinants of structural transformation of economies, and the rate of growth of productivity in the industrial (Kuznets, 1986) and agricultural sectors (Evenson and Jha, 1973) have been put forward as a key variable. Since the publication of the pioneering works of Schultz (1953), Solow (1957), and Griliches (1964), voluminous literature has appeared dealing with the measurement and analysis of productivity at different levels of aggregation. Three approaches for the measurement are the most representative: (i) the parametric approach which models the state of technology by including a time trend in the production or cost functions and the partial differentiation with respect to time to get estimates of technological changes; (ii) the accounting approach which approximates technological change by the computation of factor productivity indices, mainly the rate of change of total factor productivity indices (Christensen, 1975); and (iii) a recent approach, termed as 'non-parametric' by Chavas and Cox (1988) and Cox and Chavas (1990), which identifies a group of implied linear inequalities that a profit maximizing (or

cost minimizing) firm must satisfy and estimates the rate of TFP using linear programming. Coelli and Rao (2003) used this approach and constructed Malmquist TFP index for agriculture using FAO data base of 93 countries covering the period 1980-2000. However, the accounting approach is popular because it is easy to implement requiring no econometric estimation. The use of TFP indices gained prominence since Diewert (1976, 1978) proved that the Theil-Tornqvist discrete approximation to the Divisia index is consistent in aggregation and superlative for a linear homogeneous trans-logarithmic production function. Divisia-Tornqvist index has been used in the present study for computing the TFP for the crop sector by district, agro-eco-region and sub-region of the IGP. The output, input, and TFP indices were computed as:

**Total Output Input (TOI) index**

$$TOI_t / TOI_{t-1} = \prod_j (Q_{jt} / Q_{jt-1})^{(R_{jt}+R_{jt-1})^1/2} = A_t \quad \text{.....(4.1)}$$

**Total Input Index (TII) index**

$$TII_t / TII_{t-1} = \prod_i (X_{it} / X_{it-1})^{(S_{it}+S_{it-1})^1/2} = B_t \quad \text{.....(4.2)}$$

where,

$R_{jt}$ is the share of $j^{th}$ crop output in total revenue in the year t,

$Q_{jt}$ is the output of $j^{th}$ crop in year t,

$S_{it}$ is the share of input i in total input cost in year t,

$X_{it}$ is quantity of input i and

$p_{it}$ is price of input i in year t.

Total output and input index in period t was computed from (4.1) and (4.2) as follows.

TOI (t) = $A_1 A_2 \ldots\ldots A_t$ ..... (4.3)

TII (t) = $B_1 B_2 \ldots\ldots B_t$ .....(4.4)

Total factor productivity index (TFP)

$TFP_t = (TOI_t / TII_t)$ .....(4.5)

Equations (4.3) to (4.5) provide the index of total output, total input, and TFP, respectively for year 't'. The estimation of input, output, and TFP growth rates for any specified period has been done by fitting an exponential (or semi-log) trend equation to

the input, output, and TFP indices, respectively. Taking derivative of above equation with respect to time gives that growth rate of TFP is equal to growth rate of output index minus growth rate of input index. The annual growth rates of output index and input index were calculated using exponential trend and tested for statistical significance. TFP indices were calculated for all major crops in the state i.e, paddy, arhar, mung, urad, groundnut, seasamum, nigerseed and jute. Both main and by-products are included in output index. Farm prices are used to aggregate the output. Inputs included in input index are land, seed, fertilizer, manure, insecticide/pesticide, human labour, animal labour, machine labour, capital (working and fixed) and irrigation. Inputs are aggregated using actual prices while farm prices were used to aggregate outputs. Data on input use of human labour, bullock labour, machine labour, seed, fertilizer, FYM, insecticides, input and output prices and irrigation are taken from the cost of cultivation of principle crops in India collected under the "Comprehensive Scheme for the Study of Cost of Cultivation of Principle Crops," of the DES, GOI, which is used for measuring the total factor productivity. At the state level data from 1981 to 2003 has been used to caliculate TFP growth for major crops. As from early 1980s to 2002-3, Orissa agriculture is stagnant. Then after there is a sign of improvement in production and yield rates of major crops. The year 2002-03 is a very special year for Orossa, as it showed the record low level of production of food grains (only 43.2 million tonnes). (Table 4.1)

**Measurement of Sustainability**

At the farmers' level, sustainability concerns are being expressed that the input levels have to be continuously increased in order to maintain the yield at the old level. This poses a threat to the economic viability and sustainability of crop production. A sustainable farming system is a system in which natural resources are managed so that potential yield and the stock of natural resources do not decline over time. However, each of the components of sustainable agriculture is complex and some quantifiable measures are needed to check whether a farming system is sustainable or not. Due to the multidimensional nature of the concept of sustainability and the difficulties in determining specific threshold values for these dimensions, it may be even too ambitious to seek the absolute level of sustainability. We should probably be satisfied with the relative ranking. Lynam and Herdt (1989) proposed a non-positive trend in TFP as a good indicator of lack of sustainability of a production system. This has been widely accepted and used as an indicator of unsustainability of production (see Ethui and Spencer 1993, Cassman and Pingali 1995, Kumar *et al.*1998 ). The farming system is

sustainable if it can maintain TFP growth over time. In this study, deceleration in TFPG has been taken as a proxy of unsustainability. The TFPG was classified into two categories, viz. negative (negative and statistically significant TFPG), and positive stagnant (statistically significant TFPG).

Table 4.1. Trends in area, production and yield of field crops in Orissa

| | Area (lakh ha) | | | | Production (lakh tones) | | | | Productivity (Kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Cereals | Pulses | oilseeds | Total | Cereals | Pulses | oilseeds | Total | Cereals | Pulses | oilseeds | Total |
| 1970-71 | 49 | 8 | 3.3 | 60.3 | 44 | 5 | 2.2 | 51.2 | 898 | 552 | 652 | 2102.0 |
| 1980-81 | 52 | 17 | 7.3 | 76.3 | 51 | 9 | 4.9 | 64.9 | 982 | 514 | 658 | 2154.0 |
| 1990-91 | 50 | 21 | 11.5 | 82.5 | 59 | 11 | 9.5 | 79.5 | 1181 | 551 | 821 | 2553.0 |
| 1998-99 | 49 | 16 | 8.6 | 73.6 | 58 | 6 | 4.5 | 68.5 | 1180 | 391 | 525 | 2096.0 |
| 1999-00 | 51 | 16 | 8.5 | 75.5 | 56 | 7 | 5.7 | 68.7 | 1108 | 403 | 668 | 2179.0 |
| 2000-01 | 49 | 14 | 7.0 | 70.0 | 50 | 5 | 3.7 | 58.7 | 1032 | 365 | 531 | 1928.0 |
| 2001-02 | 49 | 17 | 8.4 | 74.4 | 75 | 7 | 5.4 | 87.4 | 1526 | 400 | 635 | 2561.0 |
| 2002-03 | 47 | 13 | 5.8 | 65.8 | 36 | 4 | 3.2 | 43.2 | 767 | 349 | 550 | 1666.0 |
| 2003-04 | 49 | 16 | 7.9 | 72.9 | 71 | 6 | 4.9 | 81.9 | 1444 | 379 | 626 | 2449.0 |
| 2004-05 | 49 | 17 | 8.4 | 74.4 | 70 | 6 | 5.2 | 81.2 | 1414 | 378 | 627 | 2419.0 |
| 2005-06 | 49 | 19 | 8.2 | 76.2 | 74 | 8 | 5.5 | 87.5 | 1513 | 422 | 668 | 2603.0 |
| 2006-07 | 49 | 19 | 8.4 | 76.4 | 74 | 9 | 6 | 89.0 | 1520 | 444 | 719 | 2683.0 |
| 2007-08 | 49 | 20 | 8.4 | 77.4 | 83 | 9 | 6.8 | 98.8 | 1695 | 458 | 804 | 2957.0 |

Source: Handbook of statistics, Government of Orissa, various issues.

**Methodology to Estimate Frontier Agricultural Production Function, Efficiency and Factors influencing Frontier Production Function**

The measured TFP is an important measure to evaluate the performance of individual crops and sustainability of a crop production system in a particular regional context. However, aggregate production performance of a particular region will also be influenced by changes in crop composition, relative prices of different crops on output side and social (literacy rate) and economic infrastructure (roads, tractors, markets, GIA, spread of HYV, use of fertilizer etc) of that region concerned. However, a number of complex conceptual issues are not adequately captured by an analysis of the kind described earlier while calculating TFP of individual crops. First, for example, HYVs and agricultural research has contributed to breaking the seasonality in crop production. Second, a great deal of efficiency has been introduced in crop production by increase in literacy rates, roads and other infrastructure at district level/state level. Finally, quality improvements and crop diversification towards commercial crops have added to the value of production at the district level aggregate production function. All of these and

many other contributions have been estimated by using district level panel data on agricultural output and inputs since 1971 to 2005. It would be worthwhile to identify these influences explicitly, which would lead to a more realistic assessment of the progress in agricultural sector.

The study employed a stochastic frontier production to estimate the technical efficiencies of resource use at district level from 1974 to 2005 i.e, 25 years of data for 13 districts, which comprises 455 data points for each variable. The estimated model is time-invariant technical efficiency frontier model. The model was specified as eqation-4.6.

$Y_i = X_i\beta + (V_i - U_i)$ --- i=1...N,----------(4.6)

Where $Y_i$ is the logarithm of the value of agricultural production of the i-th district;

$x_i$ is a $k\times1$ vector of (transformations of the) input quantities of the i-th district;

$\beta$ is a vector of unknown parameters;

the $V_i$ are random variables which are assumed to be iid. N $(0,\sigma_V^2)$, and

independent of the $U_i$, which are non-negative random variables, which are assumed to account for technical inefficiency in production, and are often assumed to be iid. $|N(0,\sigma_U^2)|$.

The efficiency will be calculated as exp $(-U_i)$ for the production function where the dependent variable is logged form.

$TE_I = f(X_I, \beta) EXP(V_i - U_i)/ f(X_I, \beta) EXP(V_i)$----------(4.7)

$0<TE<1$

$Y_i$ attains its maximum value of $f(X_I, \beta) \exp(V_i)$ and TE =1 if $U_I$ =0. Otherwise $U_I$ is not equal to 0 provides the shortfall of observed output from the maximum potential (frontier) output.

Model estimation:

The stochastic frontier production function used to analyse resource use efficiency at district level is given by equation---4.8

Ln $Y_i=\beta_0+ \beta_1 ln(GIA)+ \beta_2 ln(TOTCTL)+\beta_3 ln(NPK\_Q)+ \beta_4 ln(RAINL) + \beta_6 ln(HYV)+ \beta_7 ln(RURALLIT)+\beta_8 ln(RURAGR)+ \beta_9 ln(LROAD)+ \beta_{10} ln(TRAC\_T) + \beta_{11} ln(CER\_A)+ \beta_{12} ln(PULSE\_A)+\beta_{13} ln(OILS\_A)+ V_i - U_i$---------(4.8)

Where

Y= actual value of agricultural output of ith district (Rs.lakhs)

GIA= Gross Irrigated Area (000 ha)

TOTCTL=Total Cattle Population in the District (with adult cattle =1, goat, sheep =0.5)

NPK_Q= Quantity of Fertilizers (N+1.3*P+1.3*K) used in tonnes

RAINL = Annual Rainfall (mm)

HYV = Area Under High Yielding Varieties (000 ha)

RURALLIT= Rural Literate Population (in lakhs)

RURAGR= Agricultural worker population (in lakhs)

LROAD= Length of Road (km)

TRAC_T= Number of tractors in district

CER_A= cereal area (000 ha)

PULSE_A=pulses area (000 ha)

OILS_A= oilseeds area (000 ha)

The same production function is fitted with least squire estimates with cobb-douglas production function. The parameter estimates are direct elasticities of each input with respect to output in both the models. The frontier production function is estimated by using

1. Time-invariant Frontier production Function (Cobb-Douglas)
2. Time –decaying Frontier production Function (Cobb-Douglas)

Using the elasticities of Gross Revenue with respect to area under cereals, pulses and oilseeds, one can easily estimate the value of marginal product (EVMP) for one unit ( per ha) shift in area to cereals, pulses and oilseeds.

EVMP(CER_A )= b*(Y/CER_A)---------- (4.9)

EVMP(PULSE_A )= b*(Y/PULSE_A)----------(4.10)

EVMP(OILS_A )= b*(Y/OILS_A)----------(4.11)

**Estimation of Marketed Surplus of Principal Crops**

The study of marketed surplus response to product price movements was initiated by Raj Krishna and Behrman. It was applied to the study of marketed surplus of food grains in Northern India by Bardhan and by Shah and Pandey. In these studies, attention was centered on the response of marketed surplus to product price changes, output level, and land tenure systems. We have used the below modified version of Raj Krishna model given by Janvery and Kumar (1981) to estimate marketed surplus of major crops in Orissa. The price elasticity of marketed surplus for each crop has been measured under pure price inflation as :

Price elasticity of marketed surplus = - C/M *Price elasticity of consumption -C/M *PQ/I*Income elasticity of demand----------(4.12)

C= consumption
M= marketed surplus
P= price of commodity
Q= quantity of output
I= Income

**Primary Field Survey**

Further a field survey has been carried out in selected districts/blocks/villages to find out marketed surplus, input-output ratios, and price trends across different regions in the agricultural year 2007. For this purpose six districts based on the % area irrigation is selected for intensive field survey. i.e., from Coastal Orissa region Jagatsinghpur with highest irrigated area(63%), and Dhenkanal with lowest irrigated area (42%); from KBK region Malkangiri, Koraput, Nowrangpur and Kalahandi have been selected for survey. From each district, one block and from each block, two villages have been selected randomly. From each village 10 farmers have been selected for intensive field survey. Totally 6 villages and 140 farmers comprise our sample. Variables like acreage under each crop cost of cultivation, factor shares of fertilizer, pesticide, irrigation, labour, education level of farmers, farm assets, input/output prices, institutional factors like credit availability, membership of society, crop insurance, regulated markets, marketed surplus, consumption pattern for the year 2007.

## Chapter-V
## Results and Discussions

**Changes in Indices of Area, Yield and Production**

The increase in area and production of the crop is highly associated with their relative profitability (Kumar and Mruthyunjaya, 1989, Kumar and Resegrant, 1993). The table 5.1 presents changes in indices of area, production and yield. The average area for paddy during 1970s is 98.6 and production is 114.8 with yield index of 1166. While in the 1980s even though area is stagnant, the production indices increased to 143.1, due to increase in yield index to 1478. While in 1990s there is significant upward movement in both area index to 101.8 and yield index to 1888. During the early 2000s again there is significant increase in yield index to 2124, which contributed to production index increased to 212.6. Overall, growth rate of yield index is much higher (2.43% per annum) than the growth rate in area index (0.15%). While growth rate in production index is 2.58 during the study period. Hence we can conclude that, the gains in rice output since 1970s to early 2000s have come essentially from the steady increase in yield. Rao(1994) has argued that output growth has come essentially from the better utilization of the existing infrastructure, stepping up the use of modern inputs and extending the green revolution to new areas.

Arhar, mung, biri, kulthi, gram, fieldpea, cowpea and lentil are the pulse crops grown in the State. The major crops are arhar, mung, biri and kulthi. Pulses are grown mainly in uplands during Kharif season predominantly in inland districts & in rice fallows during Rabi season, mostly in coastal districts under available moisture condition. Mung & biri are also grown as third crop in summer under irrigated condition. Post monsoon rains, mostly govern the Rabi coverage of pulses in rice fallows. Among pulse crops, area index for arhar is higher (75.7) followed by urad(28.0) and mung (18.8) with corresponding production index of 68.8, 23.7 and 17.4 in the early 2000s. Area index for all pulse crops decreased since 1980s, area index for arhar decreased by 3.04% per annum, urad decreased by 10.7% per annum and mung decreased by 7.7% per annum. In absolute terms area index for arhar decreased from 95.2 to 76, while area under urad decreased from 114.8 to 28.0, and for mung from 84.2 to 18.8. Arhar yield index increased from 880 to 907 during the same period, while yield index of urad decreased from 949 to 838 and mung yield index decreased from 1026 to 929 with annual growth rates of 0.68%, -1.29% and –0.66% respectively. Hence overall production growth rate

for all pulse crops is negative. For arhar, growth rate of production is –2.36, urad –11.99 and for mung it was –8.36. The above figures indicates that, production of pulses decreased in Orissa, mainly due to significant decrease in area accompanied by stagnant yield.

Groundnut, til, castor, mustard, niger, sunflower, safflower, soybean, linseed are the Oilseed crops grown in the State. Out of these, groundnut, til, mustard and niger are major oilseeds crops grown. Now sunflower is gaining popularity in the state. These crops are grown in upland during Kharif season and in riverbeds & rice fallows during Rabi season. Among oilseed crops, area index for groundnut is higher (116.0) followed by nigerseed (74.5) and sesamum (70.0) with corresponding production indices of 146.6, 79.5 and 54.0 in the early 2000s. Like pulse crops area under all oilseed crops decreased since 1980s, area under groundnut decreased by 1.75% per annum, nigerseed decreased by 4.85% per annum and sesamum decreased by 6.73% per annum. In absolute terms area index for groundnut decreased from 292.3 to 116.0, while area index for nigerseed decreased from 80.0 to 74.5, and for sesamum from 84.8 to 70.0 since 1980s. Yield index of groundnut increased from 1129 to 1212, nigerseed yield index decreased from 1210 to 1049 and sesamum yield index decreased from 863 to 766 with annual growth rates of 1.69%, -3.51% and -3.25% respectively. As a result of higher negative growth rate in area for all oilseed crops, production growth rate is negative with -0.06 % per annum for groundnut, -8.35% for nigerseed and -9.99 for sesamum.

In the case of Jute, major commercial crop of Orissa also area index was reduced from 84.3 to 33.3 with a negative growth of 5.83% per annum since early 1970s. However there is perceptible increase in yield index during the period from 1003 to 1521, with a growth rate of 2.48% per annum. However because of higher negative growth in area compared to lower positive growth in yield, the overall production index is reduced from 84.4 to 51.9 with a negative growth of 3.35%.

| Table 5.1: Index of area, yield and production of crops in Orissa | | | | |
|---|---|---|---|---|
| Crop | Period | Area | Production | Yield(Kg/ha) |
| Paddy | 1974-80 | 98.6 | 114.8 | 1166 |
| Base year: 1981 | 1981-90 | 96.6 | 143.1 | 1478 |
| | 1991-00 | 101.8 | 192.2 | 1888 |
| | 2001-03 | 99.8 | 212.6 | 2124 |
| | Growth (%) | 0.15 | 2.58 | 2.43 |
| | | | | |
| Mung | 1981-90 | 84.2 | 87.3 | 1026 |
| Base year: 1981 | 1991-00 | 38.9 | 37.4 | 937 |
| | 2001-03 | 18.8 | 17.4 | 929 |
| | Growth (%) | -7.70 | -8.36 | -0.66 |
| | | | | |
| Urad | 1984-90 | 114.8 | 108.6 | 949 |
| Base year 1984 | 1991-00 | 53.2 | 47.4 | 859 |
| | 2001-03 | 28.0 | 23.7 | 838 |
| | Growth (%) | -10.70 | -11.99 | -1.29 |
| | | | | |
| Arhar | 1994-00 | 95.2 | 83.7 | 880 |
| Base year 1994 | 2001-03 | 75.7 | 68.8 | 907 |
| | Growth (%) | -3.04 | -2.36 | 0.68 |
| | | | | |
| Groundnut | 1975-80 | 124.1 | 107.4 | 857 |
| Base year 1981 | 1081-90 | 292.3 | 332.0 | 1129 |
| | 1991-98 | 116.0 | 146.6 | 1212 |
| | Growth (%) | -1.75 | -0.06 | 1.69 |
| | | | | |
| Sesamum | 1997-2000 | 84.8 | 73.8 | 863 |
| Base year 1997 | 2001-03 | 70.0 | 54.0 | 766 |
| | Growth (%) | -6.73 | -9.99 | -3.25 |
| | | | | |
| Nigerseed | 1997-00 | 80.0 | 95.7 | 1210 |
| Base year 1997 | 2001-03 | 74.5 | 79.5 | 1049 |
| | Growth (%) | -4.85 | -8.35 | -3.51 |
| | | | | |
| Jute | 1973-80 | 84.3 | 84.4 | 1003 |
| Base year 1981 | 1981-90 | 75.3 | 111.2 | 1464 |
| | 1991-96 | 33.3 | 51.9 | 1521 |
| | Growth (%) | -5.83 | -3.35 | 2.48 |

The nominal cost per unit of output is showing an upward trend in spite of growth in yield due to technical change. However, the question must be assessed whether the increase in nominal unit cost of production came mostly from an increase in prices of farm inputs at a rate higher than the rise in productivity or due to higher use of inputs in real terms for obtaining the same yield. This question was examined by assessing cost of production at constant prices. The unit cost of production was deflated by an input price index series to obtain the cost of production at constant prices. Annual growth rate in real cost of production is computed and the results are given in Table 5.2.

Real price of inputs (real cost) have been increased for all the crops except arhar and sesamum. While real price of output increased for only few crops like urad, mung, groundnut, jute and decreased for paddy, arhar, sesamum and nigerseed. Even for the crops for which real price is increased, the increase in real price is less than the increase in the real cost. Which indicates that the terms of trade has gone against agricultural sector. Real cost of production index for rice increased from 115.4 to 163.3 from 1970s to early 2000s, the real price increased from 83.9 to 56.0 during the same period with a growth rate of 1.8% per annum in real cost and –0.85% per annum in real price of output in paddy.

Among pulses, real cost of production increased for urad and mung from 103.8 to 119.1 and 110.2 to 138.7 respectively since early 1980s. While real price of output for urad and mung decreased from 104.8 to 94.4 and from 114.3 to 111.8 respectively with a CAGR of 0.61% and 1.1% respectively. Even though, there is a significant hike in real price of output during 1990s for both urad and mung, they tapered off in the early 2000s. In the case of arhar, both real cost and real price of output decreased since early 1990s, however, decrease in real price is much higher than the decrease in real cost, which might have effected profitability of arhar adversely.

| Table 5.2: Real Input-output price parity of crops in Orissa | | | |
|---|---|---|---|
| CROP | YEAR | Real Price Input Index | Real Price Output Index |
| Paddy | 1974-80 | 115.4 | 83.9 |
| | 1981-90 | 124.3 | 75.7 |
| | 1991-00 | 163.3 | 78.1 |
| | 2001-03 | 163.3 | 56.0 |
| | Growth (%) | 1.80 | -0.85 |
| | | | |
| Mung | 1981-90 | 110.2 | 114.3 |
| | 1991-00 | 135.9 | 140.0 |
| | 2001-03 | 138.7 | 111.8 |
| | Growth (%) | 1.8 | 1.1 |
| | | | |
| Urad | 1984-90 | 103.8 | 104.8 |
| | 1991-00 | 124.1 | 131.1 |
| | 2001-03 | 119.1 | 94.4 |
| | Growth (%) | 1.39 | 0.61 |
| | | | |
| Arhar | 1994-00 | 96.7 | 100.2 |
| | 2001-03 | 89.7 | 73.5 |
| | Growth (%) | -1.03 | -5.78 |
| | | | |
| Groundnut | 1975-80 | 108.1 | 131.7 |
| | 1081-90 | 125.3 | 138.4 |
| | 1991-98 | 168.2 | 145.6 |
| | Growth (%) | 2.46 | 0.74 |
| | | | |
| Sesamum | 1997-2000 | 91.5 | 94.7 |
| | 2001-03 | 84.3 | 79.0 |
| | Growth (%) | -1.96 | -4.51 |
| | | | |
| Nigerseed | 1997-00 | 119.2 | 98.5 |
| | 2001-03 | 136.8 | 83.8 |
| | Growth (%) | 4.91 | -3.71 |
| | | | |
| Jute | 1973-80 | 112.7 | 90.3 |
| | 1981-90 | 131.6 | 85.0 |
| | 1991-96 | 158.5 | 97.5 |
| | Growth (%) | 2.13 | 0.65 |

In the case of oilseeds, real price of inputs increased from 108.1 to 168.2 for groundnut, from 119.2 to 136.8 for nigerseed from 1970s to 1990s. While real input cost is slightly decreased for sesamum from 91.5 to 84.3 during late 1990s and early 2000. The growth rate of real input cost is higher for nigerseed (4.91% per annum), followed by groundnut (2.46) and for sesamum it was negative (-1.96 per annum). Real output price for sesamum reduced from 94.7 to 79.0, for nigerseed it reduced from 98.5 to 83.8, while for groundnut it slightly increased from 131.7 to 145.6. For all oilseeds the growth in real price of output is much less than the growth rate in real input cost. It also indicates that the prices movement for oilseed farmers is unfavourable during the 1990s and 2000. In the case of commercial crop jute, real input cost index reduced from 112.7 to 158.5 with a growth rate of 2.13 % per annum. While the real price of output increased from 90.3 to 97.5 with a growth rate of 0.65% per annum.

The main reason for the raise in real cost of production for most of the crops is due to increase in use of purchased inputs and also transformation of agricultural sector from subsistence to commercial farming both input and output side. The adoption of yield enhancing inputs like HYVs, fertilizer, pesticides, irrigation pump sets, and tractors increased since early 1980s, even though phase of transformation is slow. However, growth in yield is slower when compared to increase in input use due to structural bottlenecks in Orissa agriculture, such as monoculture of paddy, lower level of market and other agricultural efficiency improving technology. In the 1990s and early 2000s due to due to liberalization and globalisation, agricultural commodity prices decreased in Orissa inline with international markets. As a result, real output price for most of the commodities decreased or increased at slower phase than real cost of production.

**Profitability and Costs**

Profitability and cost of production in nominal terms has been given in Table 5.3. Profitability of agricultural sector has come down significantly for all crops even in nominal terms in TE 2003 compared to 1990s. The mean cost of cultivation for paddy in 1980s is Rs.1426.9 per ha, while gross returns are Rs.1745.9 per ha with a resulting profit margin of 23.1% over costs. But due to growth rate in costs per ha (10.36%) is much higher than the growth in gross returns per ha (9.43%), the profit margin declined to 0.6% in early 2000s. The cost per quintal of output increased from Rs.70.4 in 1970s to Rs.440.6 TE 2003 with a growth rate of 8.6%. While profit per quintal of paddy is

increased initially from Rs.15.7 in 1970s to Rs.39.7 in 1990s but again it declined to Rs. 2.5 per ha in TE 2003.

Cost of cultivation for mung increased from Rs.1393.8 per ha in 1980s to Rs.5500 per ha in TE 2003 with a growth rate of 9.44% per annum. While gross returns per ha increased from Rs.1766.9 per ha to Rs. 5569.9 per ha during the same period with a growth rate of 8.03% per annum. As growth in costs is higher than growth in gross returns, profit per ha came down from Rs.373.1 per ha to Rs. 69.9 per ha with a negative growth of 1.41% per annum. Consequently profit margin declined from 26.8% to 1.3 % over costs. While cost per quintal of output increased from Rs.429.2 to Rs.1896.5 and profit per quintal of output declined from a profit of Rs.114.9 to Rs. 24.1 per quintal. Cost per quintal of output increased by 7.9% per annum, while profit per quintal of output declined by 0.8% per annum.

Gross returns and costs per ha for urad are somewhat higher side than mung, profit per ha and profit margin is also slightly higher than mung. Cost per quintal of output is lower than mung, while profit per quintal is higher than mung. Gross returns per ha increased from Rs.2341.3 per ha to Rs. 6147.4 per ha from 1980s to TE 2003. The gross returns per ha increased by 7.17%, while costs per ha increased at higher level (9.54%). As a result profit margin decreased from 45.1% to 0.8 % over costs. However cost and profit per quintal is more for both urad and mung compared to main crop paddy. For arhar also cost of cultivation and cost of production are similar to other pulse crops like urad and mung. Profitability of arhar and other two pulse crops increased during 1990s and then after it decreased in 2000s. Increase in growth rate of gross returns per ha is lower (2.47% per annum) than increase in costs per ha (4.85%). As a result profit margin decreased from 10.0 % over costs to 0.1 % during the same period.

**Table 5.3: Profitability of crops in Orissa**

| CROP | YEAR | Gross Returns Rs./ha | Cost Rs./ha | Profit Rs./ha | Margin % | Cost Rs./q of output | Profit Rs./q of output |
|---|---|---|---|---|---|---|---|
| Paddy | 1974-80 | 1745.9 | 1426.9 | 319 | 22.4 | 70.4 | 15.7 |
| | 1981-90 | 4086.6 | 3393.9 | 692.7 | 20.4 | 126.8 | 25.9 |
| | 1991-00 | 11704.4 | 10448.8 | 1255.6 | 12.0 | 330.0 | 39.7 |
| | 2001-03 | 15385.5 | 15300 | 85.5 | 0.6 | 440.6 | 2.5 |
| | Growth (%) | 9.43 | 10.36 | -0.93 | -3.3 | 8.6 | -0.5 |
| | | | | | | | |
| Mung | 1981-90 | 1766.9 | 1393.8 | 373.1 | 26.8 | 429.2 | 114.9 |
| | 1991-00 | 4416.8 | 3786.2 | 630.6 | 16.7 | 1284.5 | 213.9 |
| | 2001-03 | 5569.9 | 5500 | 69.9 | 1.3 | 1896.5 | 24.1 |
| | Growth (%) | 8.03 | 9.44 | -1.41 | -2.7 | 7.9 | -0.8 |
| | | | | | | | |
| Urad | 1984-90 | 2341.3 | 1614.1 | 727.2 | 45.1 | 338.5 | 152.5 |
| | 1991-00 | 5342.3 | 4196.9 | 1145.4 | 27.3 | 1023.1 | 279.2 |
| | 2001-03 | 6147.4 | 6100 | 47.4 | 0.8 | 1509.2 | 11.7 |
| | Growth (%) | 7.17 | 9.54 | -2.37 | -3.8 | 8.0 | -1.3 |
| | | | | | | | |
| Arhar | 1994-00 | 5698.8 | 5181.3 | 517.5 | 10.0 | 1211.8 | 121.0 |
| | 2001-03 | 6406.1 | 6400 | 6.1 | 0.1 | 1473.3 | 1.4 |
| | Growth (%) | 2.47 | 4.85 | -2.38 | -3.9 | 4.0 | -1.3 |
| | | | | | | | |
| Groundnut | 1975-80 | 2199.1 | 1771.1 | 428 | 24.2 | 204.0 | 49.3 |
| | 1081-90 | 6010.6 | 4165.1 | 1845.5 | 44.3 | 358.9 | 159.0 |
| | 1991-98 | 13700.6 | 10694.5 | 3006.1 | 28.1 | 881.9 | 247.9 |
| | Growth (%) | 10.46 | 10.4 | 10.27 | -0.14 | 8.72 | 8.57 |
| | | | | | | | |
| Sesamum | 1997-2000 | 5436.9 | 4929.7 | 507.2 | 10.3 | 1670.3 | 171.9 |
| | 2001-03 | 5425.3 | 5400 | 25.3 | 0.5 | 2078.9 | 9.7 |
| | Growth (%) | 0.52 | 5.43 | -4.91 | -9.4 | 4.5 | -2.7 |
| | | | | | | | |
| Nigerseed | 1997-00 | 5043.5 | 4753.8 | 289.7 | 6.1 | 1123.2 | 68.4 |
| | 2001-03 | 4926.6 | 4900 | 26.6 | 0.5 | 1406.0 | 7.6 |
| | Growth (%) | 0.99 | 5.56 | -4.57 | -1.8 | 4.6 | -2.5 |
| | | | | | | | |
| Jute | 1973-80 | 2018.7 | 1704.9 | 313.8 | 18.4 | 132.1 | 24.3 |
| | 1981-90 | 6035.3 | 4364.9 | 1670.4 | 38.3 | 206.4 | 79.0 |
| | 1991-96 | 13468.3 | 9994 | 3474.3 | 34.8 | 487.1 | 169.3 |
| | Growth (%) | 11.2 | 10.52 | 14.89 | 2.6 | 7.83 | 11.16 |

All oilseed crops like groundnut, sesamum and niger are profitable in 1990s, while their profitability decreased in TE 2003. Among all oilseeds, gross returns and costs per ha for groundnut is much higher with Rs.13700.6 and Rs.10694.5, with a profit per ha of Rs.3006.1. Both gross return and cost per ha increased by about 10% per annum from 1975 to 1998. Even though profit margin is consistently higher than other crops for groundnut, which is 24 % in 1970s, increased to 44 % in the 1980s, however it again reduced to 28 % in the 1990s its growth rate per annum is negative (-0.14%). Its profit per quintal of output increased from Rs.49.5 in 1970s to Rs.247.9 in 1990s, with a CAGR of 8.57%.

Gross returns and also costs per ha for both sesamum and niger are about Rs.5000 to Rs.6000 during late 1990s and TE 2003. CAGR of costs are much higher (about 5.5%) while gross returns are less than 1% per annum. As a result profit per ha and profit margin declined significantly. Cost per quintal of output increased from Rs.1670.3 to Rs.2078.9 for sesamum and from Rs.1123.2 to Rs.1406.0 for nigerseed with a growth rate of 4.5 % and 4.6 % per annum respectively. In case of jute gross returns and costs have been increased in double-digit growth from 1970s to 1990s. Gross returns have increased from Rs. 2018.7 to Rs.13, 468.3 per ha, while costs per ha increased from Rs.1704.9 to Rs.9994.0 per ha. Profit margin increased from 18.4 % to 34.8 % during the same period.

Overall, profitability in absolute terms and also growth rate is higher for groundnut and jute compared to other crops. While for all other crops even though profitability increased during 1990s, it came down in TE 2003. For most of the crops, increase in cost per ha is much higher than the increase in gross revenue hence there is decline in profitability and profit margins in early 2000s.And the productivity is stagnant for all crops including paddy which is a major staple crop of Orissa.

**Trends in Partial Productivity of Land, labour and Fertilizer**

The indices of land, labour and fertilizer partial productivity were calculated for all the years and presented averages and for 1970s, 1980s, 1990s and TE 2003. Annual growth rates are also calculated for the whole period. The results are presented in Table 5.4. Land productivity was increased for paddy, groundnut and jute, while for pulse crops (Urad and Mung) land productivity declined. Labour productivity growth again positive for paddy, groundnut and jute, while negative for urad and mung. While partial productivity

growth of fertilizer is positive for urad and for all other crops it was negative. The notable productivity gains have come from more efficient use of existing inputs of land and labour. The increased labour productivity was a result of reduced use of labour on account of mechanization. Similarly, the increase in land productivity has taken place in the paddy, groundnut and jute on account of increase in land saving modern inputs, particularly fertilizer. It is to be noted that there is significant fall in the productivity of fertilizer because increasing amounts of fertilizer are being used to maintain current yield levels. The achievement of relatively high levels of fertilizer use on paddy has shifted concern from simply increasing the level of use to improving the efficiency of fertilizer use. Yield-based growth has rapidly increased nutrient removal from the soil at a rate that has not been matched by balanced growth in the supply of nutrients through chemical and organic fertilizers. The result of unbalanced application of fertilizers has been a decline in the efficiency of fertilizer use over time (Kumar and Mruthyunjaya 1992).

| Table 5.4: Indices of Partial factor productivity of labour, fertilizer and land in Orissa | | | | |
|---|---|---|---|---|
| CROP | YEAR | Land | Labour | Fertilizer |
| Paddy | 1974-80 | 116.6 | 96.4 | 114.4 |
| | 1981-90 | 147.8 | 106.5 | 73.3 |
| | 1991-00 | 188.8 | 133.0 | 39.6 |
| | 2001-03 | 212.4 | 146.6 | 30.7 |
| | Growth (%) | 2.43 | 1.68 | -5.43 |
| | | | | |
| Arhar | 1994-00 | 92.5 | 103 | 247.0 |
| | 2001-03 | 119.8 | 116.8 | 230.5 |
| | Growth (%) | -0.22 | -0.30 | 0.17 |
| | | | | |
| Mung | 1981-90 | 102.6 | 96.8 | 13.0 |
| | 1991-00 | 93.7 | 97.5 | 5.4 |
| | 2001-03 | 92.9 | 89.7 | 4.0 |
| | Growth (%) | -0.66 | -0.38 | -3.20 |
| | | | | |
| Urad | 1984-90 | 94.9 | 92.8 | 68.0 |
| | 1991-00 | 85.9 | 73.6 | 163.0 |
| | 2001-03 | 83.8 | 76.2 | 271.4 |
| | Growth (%) | -1.29 | -1.86 | 6.61 |
| | | | | |
| Groundnut | 1975-80 | 85.7 | 97.4 | 90.9 |
| | 1081-90 | 112.9 | 128.7 | 75.7 |
| | 1991-98 | 121.2 | 213.7 | 41.5 |
| | Growth (%) | 1.69 | 2.86 | -5.05 |
| | | | | |
| Jute | 1973-80 | 100.3 | 102.3 | 61.2 |
| | 1981-90 | 146.4 | 148.4 | 44.7 |
| | 1991-96 | 152.1 | 163.9 | 32.8 |
| | Growth (%) | 2.48 | 2.66 | -4.38 |

**Trends in Total Factor Productivity and Real Cost of Production**

The average annual growth rates of output, inputs, TFP and real cost of production indices are given in Table 5.5. The results revealed that for paddy, the input index during 1974-2003 has risen at the rate of 1.49% whereas it declined for all other crops, (-) 7.16 percent for mung, (-) 9.74 percent for urad, (-) 3.47 percent for arhar, (-) 1.12 percent for groundnut, (-) 5.60 percent for sesamum, (-) 6.86 percent for nigerseed and (-) 4.99 percent for Jute. With the increase in inputs, output growth of paddy increased by 2.57% per annum, output growth of groundnut is also in the positive range due to positive technological change is higher than negative growth in input index. For mung,

urad, sesamum and nigerseed output declined by more than 5 per cent per annum, while for jute and arhar decline in output index is less than 5 percent. Overall TFP index is raised by 1.08 per cent for paddy, by 1.13 percent for Arhar, by 1.21 percent for groundnut and by 1.56 percent for jute. While TFP index is declined by 1.17 percent for mung, by 2.44 percent for urad, by 4.37 percent for sesamum and by 1.62 percent for nigerseed. Real cost of production per quintal is declined by 1.53 percent for paddy, by 2.29 percent for arhar, by 1.77 percent for groundnut, by 3.98 percent for nigerseed, and by 2.26 percent for jute, while it is increased by 2.55 percent for sesamum, by 1.83 percent for urad and 0.82 percent for mung. The productivity or technical change is responsible for 41.97 percent of output growth for paddy, 13.99 percent for mung and 20.0 percent for urad. The productivity change or technological change is responsible for 41 percent of total output growth in paddy.

The stagnation in Orissa agricultural sector further accentuated by slow growth in TFP growth (1.08% per annum) of paddy in the state, which occupy about 80% of the cropped area. Negative TFP growth in major pulse and oilseed crops like mung, urad, sesamum and niger, discouraged crop diversification towards these crops. Which ultimately effected expansion of area under these crops, and hindered growth in gross cropped area and cropping intensity. Cropping intensity is still far less than easily achievable 200% in water abundant state.

**Table 5.5: TFP and cost of production per unit of output at constant price**

| Crop | Period | Input Index | Output Index | TFP Indices | Real cost of production at constant price (Rs/Q) |
|---|---|---|---|---|---|
| Paddy | 1974-80 | 108.0 | 114.6 | 106.0 | 55.2 |
| | 1981-90 | 122.3 | 142.4 | 115.8 | 47.0 |
| | 1991-00 | 143.5 | 191.1 | 133.9 | 39.7 |
| | 2001-03 | 152.7 | 212.3 | 138.7 | 38.0 |
| | Growth | 1.49 | 2.57 | 1.08 | -1.53 |
| | | | | | |
| Mung | 1981-90 | 90.8 | 87.6 | 95.3 | 285.3 |
| | 1991-00 | 43.3 | 37.8 | 85.2 | 310.2 |
| | 2001-03 | 22.7 | 17.3 | 77.2 | 324.7 |
| | Growth | -7.16 | -8.33 | -1.17 | 0.82 |
| | | | | | |
| Urad | 1984-90 | 117.0 | 108.0 | 92.7 | 262.8 |
| | 1991-00 | 60.4 | 46.1 | 72.1 | 322.4 |
| | 2001-03 | 32.7 | 23.0 | 69.8 | 326.7 |
| | Growth | -9.74 | -12.18 | -2.44 | 1.83 |
| | | | | | |
| Arhar | 1994-00 | 84.4 | 83.0 | 98.5 | 1056.3 |
| | 2001-03 | 67.0 | 68.7 | 103.8 | 969.3 |
| | Growth | -3.47 | -2.34 | 1.13 | -2.29 |
| | | | | | |
| Groundnut | 1975-80 | 117.3 | 107.3 | 90.4 | 174.0 |
| | 1081-90 | 303.8 | 336.4 | 110.9 | 135.6 |
| | 1991-98 | 125.0 | 150.0 | 122.3 | 123.5 |
| | Growth | -1.12 | 0.09 | 1.21 | -1.77 |
| | | | | | |
| Sesamum | 1997-2000 | 83.5 | 74.3 | 88.3 | 1654.3 |
| | 2001-03 | 70.3 | 54.3 | 77.0 | 1802.8 |
| | Growth | -5.60 | -9.97 | -4.37 | 2.55 |
| | | | | | |
| Nigerseed | 1997-00 | 77.8 | 96.0 | 127.1 | 858.8 |
| | 2001-03 | 66.7 | 79.3 | 118.0 | 742.5 |
| | Growth | -6.86 | -8.48 | -1.62 | -3.98 |
| | | | | | |
| Jute | 1973-80 | 93.8 | 84.6 | 91.3 | 85.9 |
| | 1981-90 | 91.4 | 110.5 | 119.7 | 55.9 |
| | 1991-96 | 41.3 | 51.3 | 120.5 | 55.7 |
| | Growth | -4.99 | -3.43 | 1.56 | -2.26 |

**Inter-district and regional variations**

It is observed that there are wide variations in agricultural performance in Orissa across zones and districts. There are broadly four agro-climatic zones in Orissa : Northern Plateau, Central Table Land, Eastern Ghat and Coastal Plain. Though Orissa has 30 districts since 1993, we have presented the data for the old undivided 13 districts for the purpose of showing changes in different agricultural indicators since 1971 onwards and also for application of econometric analysis. Table 5.6 shows that during 2006 yield rate of foodgrains was the highest in Coastal Plain followed by Central Table Land, Eastern Ghat and Northern Plateau in that order. Inter-district comparison in yield rate of food grains shows that it ranges from the highest 1481 kg/ha in Baleswar to the lowest 880.5 kg/ha in Kalahandi. Irrigation is the most important determining factor of agricultural productivity. GIA as per cent of GCA is the highest, 54.2 per cent, for Baleswar district and the lowest, 23.9 per cent, for Kendujar. The districts baleswar and sambalpur are ranked highest in fertilizer consumption per ha GCA with 98.8 kg per ha and 77.1 kg per ha respectively. While districts Dhenkanal and Phulbani are ranked lowest with 22.0 and 20.6 kg per ha. In the same way coastal (53.4kg/ha) and central (48.5kg/ha) regions ranked highest in fertilizer consumption per ha, while northern plateau region ranked lowest with 30 kg per ha as in the case of yield of food grains. Baleswar (Rs.5338 per ha) and Dhenkanal (Rs.4379 per ha) are highest in credit uptake per ha of GCA, while Kalahandi (Rs.1333.8) and Phulbani(Rs.1171.8) are ranked lowest. Central region ranked highest, while eastern region ranked lowest in credit uptake per ha of GCA. Cuttack, Puri and baleswar three coastal districts ranked highest in rural literacy rate, while Korapur, Kalahandi and Mayurbhan are ranked lowest. As expected coastal region ranked highest in rural literacy, while eastern ghat region ranked lowest.

A careful analysis of the data for different districts reveals that the four coastal districts (Balasore, Cuttack, Puri and Ganjam) and two districts of Central Table Land Area (Sambalpur and Bolangir) are agriculturally more advanced than other districts. The agricultural success of four coastal districts is due to well-developed irrigation facilities and vast tracts of plain and fertile land comprising alluvial soil. Districts of northern plateau zone namely Mayurbhanj, Keonjhar and Sundergarh, and Koraput of eastern ghat area are found to be the most backward districts.

| Table 5.6. Inter-regional and inter-district variations in important agricultural sector indicators TE 2006 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Food grain (000 ha) | Food grain Yield (kg/ha) | Food grain production (000 tonnes) | NSA (000 ha) | GCA (000 ha) | Cropping intensity (%) | Fertilizer Consumption (Mt) | Fertilizer Consumption per ha (kg/ha) | Rainfall (mm) | GIA (000 ha) | GIA%/GCA | crop loan (Rs./ha) | average farm size (ha) | % rural Literacy |
| **I** | **NORTHERN PLATEAU** | **982.4** | **1206.1** | **1184.8** | **961.0** | **1285.0** | **100.0** | **38724.0** | **30.1** | | **342.4** | **26.6** | 2127.5 | **1.4** | **32.6** |
| 1 | Mayurbhanj | 394.4 | 1395.6 | 550.44 | 380 | 488.94 | 128.7 | 17846.0 | 36.5 | 1029.6 | 143.33 | 29.31 | 1885.1 | 1.25 | 28.8 |
| 2 | Kendujhar | 294.49 | 1084.7 | 319.43 | 281 | 421.05 | 149.8 | 11805.0 | 28.0 | 1006.9 | 101.02 | 23.99 | 1964.8 | 1.28 | 34.5 |
| 3 | Sundargarh | 293.48 | 1073.1 | 314.93 | 300 | 374.97 | 125.0 | 9073.0 | 24.2 | 1090.5 | 98.03 | 26.14 | 2626.1 | 1.73 | 34.4 |
| **II** | **CENTRAL TABLE LAND** | **1663.3** | **1341.1** | **2230.6** | **1432.0** | **2203.6** | **100.0** | **106874.0** | **48.5** | | **699.1** | **31.7** | 3023.3 | **1.5** | **37.0** |
| 4 | Bolangir | 525.07 | 1279.4 | 671.76 | 437 | 660.29 | 151.1 | 21001.0 | 31.8 | 862.0 | 181.82 | 27.54 | 1531.6 | 1.61 | 30.5 |
| 5 | Sambalpur | 738.42 | 1581.1 | 1167.5 | 637 | 941.67 | 147.8 | 72630.0 | 77.1 | 1059.6 | 368.5 | 39.13 | 3202.9 | 1.71 | 38.3 |
| 6 | Dhenkanal | 399.79 | 978.9 | 391.34 | 358 | 601.63 | 168.1 | 13243.0 | 22.0 | 1090.1 | 148.75 | 24.72 | 4379.3 | 1.22 | 42.3 |
| **III** | **EASTERN GHAT** | **1684.2** | **1107.2** | **1864.8** | **1459.0** | **2291.8** | **100.0** | **87349.0** | **38.1** | | **681.9** | **29.8** | 1432.4 | **1.7** | **22.4** |
| 7 | Koraput | 804.18 | 1273.5 | 1024.11 | 737 | 1127.48 | 153.0 | 43240.0 | 38.4 | 1151.0 | 324.07 | 28.74 | 1581.0 | 1.7 | 14.3 |
| 8 | Kalahandi | 668.81 | 888.3 | 594.13 | 523 | 839.3 | 160.5 | 37427.0 | 44.6 | 1051.0 | 278.29 | 33.16 | 1333.8 | 1.89 | 23.5 |
| 9 | Phulbani | 211.16 | 1167.5 | 246.53 | 199 | 324.97 | 163.3 | 6682.0 | 20.6 | 1043.9 | 79.51 | 24.47 | 1171.8 | 1.38 | 29.5 |
| **IV** | **COASTAL PLAIN** | **2510.1** | **1202.3** | **3017.8** | **1802.0** | **3180.1** | **100.0** | **169929.0** | **53.4** | | **1426.0** | **44.8** | **3854.7** | **1.10** | **45.8** |
| 10 | Baleswar | 467.24 | 1481.3 | 692.1 | 403 | 575.66 | 142.8 | 56849.0 | 98.8 | 1203.5 | 312.05 | 54.21 | 5338.4 | 1.19 | 48 |
| 11 | Cuttack | 802.19 | 1023.1 | 820.75 | 549 | 1028.64 | 187.4 | 43427.0 | 42.2 | 1371.9 | 480.44 | 46.71 | 3539.3 | 1.05 | 51.5 |
| 12 | Puri | 597.43 | 1115.7 | 666.55 | 397 | 740.41 | 186.5 | 32282.0 | 43.6 | 1043.9 | 313.81 | 42.38 | 3586.7 | 1.01 | 50.9 |
| 13 | Ganjam | 643.2 | 1303.5 | 838.41 | 453 | 835.34 | 184.4 | 37371.0 | 44.7 | 1149.5 | 319.67 | 38.27 | 3458.2 | 1.03 | 32.7 |
| | **Orissa** | **6839.86** | **1206.0** | **8297.98** | **5654** | **8960.35** | **158.5** | **402876** | **45.0** | | **3149.29** | **35.15** | **2783.0** | **1.34** | **34.5** |

**Table 5.7: District-wise trends in Production (000 t), and yield (quintals/ha) of cereals, pulses, oilseeds and other crops**

| Period | Northern Plateau | | | Central Table Land | | | Eastern Ghat | | | Coastal Plain | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cereal production | | | | | | | | | | | | | |
| | Mayurbhanj | Keonjhar | Sundergarh | Dhenkanal | Bolangir | Sambalpur | Koraput | Kalahandi | Phulbani | Balasore | Cuttack | Ganjam | Puri |
| 1971-80 | 308.1 | 191.2 | 198.7 | 259.3 | 267.1 | 569.0 | 363.6 | 219.9 | 98.7 | 360.4 | 607.1 | 365.9 | 423.9 |
| 1981-90 | 345.6 | 193.9 | 193.1 | 261.3 | 360.0 | 672.9 | 438.0 | 251.3 | 127.1 | 416.4 | 649.1 | 455.3 | 479.4 |
| 1991-2000 | 423.0 | 236.4 | 217.7 | 336.1 | 425.6 | 764.1 | 609.7 | 409.4 | 225.8 | 562.5 | 584.0 | 523.5 | 581.8 |
| 2001-05 | 503.2 | 297.1 | 240.0 | 403.2 | 487.4 | 1020.3 | 757.0 | 438.2 | 191.7 | 730.6 | 608.5 | 534.9 | 566.7 |
| Pulses production | | | | | | | | | | | | | |
| 1971-80 | 4.8 | 2.1 | 4.4 | 4.5 | **2.9** | 3.3 | **21.3** | **10.1** | 5.6 | 1.2 | **12.3** | **6.1** | 3.8 |
| 1981-90 | 10.6 | 7.3 | 7.5 | 14.1 | **10.1** | 5.7 | **35.4** | **22.2** | 11.7 | 1.7 | **15.4** | **14.1** | 5.2 |
| 1991-2000 | 7.9 | 7.1 | 6.7 | 10.2 | **7.7** | 7.7 | **31.5** | **19.4** | 6.7 | 1.7 | **23.2** | **14.5** | 9.6 |
| 2001-05 | 7.3 | 8.1 | 4.0 | 8.6 | **11.5** | 7.7 | **21.3** | **23.2** | 7.1 | 1.7 | **23.6** | **22.1** | 10.0 |
| Oilseed production | | | | | | | | | | | | | |
| 1971-80 | 6.3 | 3.5 | 5.7 | 24.7 | 13.9 | 36.4 | 15.7 | 16.6 | 7.7 | 6.6 | 53.6 | 30.8 | 16.8 |
| 1981-90 | 12.7 | 15.6 | 14.7 | 89.5 | 42.0 | 76.9 | 29.9 | 42.2 | 17.0 | 32.1 | 171.8 | 75.9 | 42.9 |
| 1991-2000 | 8.0 | 5.5 | 6.5 | 26.8 | 17.5 | 43.6 | 26.2 | 17.0 | 13.3 | 10.2 | 42.3 | 19 | 21.7 |
| 2001-05 | 2.8 | 0.6 | 1.5 | 4.8 | 10.1 | 20.8 | 8.1 | 2.2 | 1.0 | 3.4 | 8.6 | 7.4 | 4.9 |
| Cereals Yield | | | | | | | | | | | | | |
| 1971-80 | 8.27 | 7.97 | 7.67 | 7.86 | 8.29 | 9.59 | 8.51 | 7.24 | 8.02 | 8.34 | 9.46 | 10.00 | 9.89 |
| 1981-90 | 10.15 | 8.77 | 8.27 | 10.4 | 11.16 | 13.51 | 11.00 | 7.97 | 10.77 | 10.59 | 11.71 | 14.25 | 11.97 |
| 1991-2000 | 20.07 | 12.12 | 8.99 | 12.91 | 16.13 | 14.62 | 12.43 | 11.11 | 12.34 | 13.81 | 12.57 | 15.71 | 13.41 |
| 2001-05 | 14.95 | 13.72 | 10.04 | 13.88 | 14.00 | 18.42 | 13.36 | 11.35 | 13.99 | 17.91 | 16.24 | 16.10 | 14.79 |
| Pulses Yield | | | | | | | | | | | | | |
| 1971-80 | 1.25 | 0.79 | 1.37 | 0.6 | 0.51 | 0.69 | 2.36 | 0.92 | 1.27 | 0.32 | 0.53 | 0.31 | 0.22 |
| 1981-90 | 11 | 1.15 | 1.26 | 0.86 | 0.73 | 0.49 | 2.25 | 1.11 | 1.39 | 0.19 | 0.5 | 0.63 | 0.27 |
| 1991-2000 | 3.75 | 3.68 | 2.71 | 1.79 | 1.74 | 2.09 | 8.87 | 2.49 | 2.12 | 1.52 | 3.03 | 1.51 | 1.29 |
| 2001-04 | 6.92 | 7.65 | 5.33 | 4.48 | 4.48 | 3.72 | 6.09 | 5.63 | 6.07 | 2.95 | 3.43 | 3.34 | 2.13 |
| Oilseed Yield | | | | | | | | | | | | | |
| 1971-80 | 6.85 | 4.45 | 5.78 | 6.87 | 5.73 | 9.48 | 5.19 | 4.93 | 3.3 | 6.96 | 11.28 | 7.35 | 6.82 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981-90 | 7.07 | 6.49 | 6.43 | 9.68 | 7.01 | 9.21 | 5.66 | 6.43 | 4.68 | 9.76 | 14.22 | 9.6 | 9.78 |
| 1991-2000 | 8.63 | 4.51 | 4.58 | 5.6 | 5.41 | 16.21 | 6.59 | 6.99 | 3.89 | 7.92 | 8.46 | 8.01 | 6.99 |
| 2001-05 | 8.19 | 3.24 | 3.41 | 4.43 | 6.36 | 6.97 | 4.35 | 4.01 | 1.88 | 6.92 | 10.39 | 7.23 | 7.76 |

A significant proportion of gross cropped area in these districts is under rainfed agriculture and, thus, drought prone. Phulbani is the only district having sliding or worsening food grain production over the reference time period (Table 5.7). District-wise production and yield trends of major crops from 1971 to 2004 have been presented in Table 5.7. In case of cereal production, Sambalpur ranked first with 1020.3 thousand tones, followed by Koraput (757 thousand tones), Balasore (730.6 thousand tones), and Cuttack (608.5 thousand tones). Except phulbani, in all districts cereal production increased significantly during reference period. While in case of pulse crops, Cuttack (23.6 thousand tones) followed by kalahandi (23.2 thousand tones), Koraput(21.3 thousand tones) and Ganjam (22.1 thousand tones) are major producers. Among these districts Koraput showed significant decline in production.

Cuttack, Sambalpur, Ganjam and Dhenkanal are major oilseed producers in 1970s. Production of oilseeds drastically reduced in all the districts since 1990s. Now only Sambalpur and Bolangir are having significant production of oilseeds, while all other districts contributes very little oilseed production. Cereal yield is highest in Sambalpur (18.42 q/ha) followed by Balasore (17.91 q/ha) and Cuttack (16.24 q/ha). While pulses yield is highest in Koenjhar (7.65 q/ha ), Mayurbhanj(6.92 q/ha), koraput (6.09 q/ha) and phulbani (6.07 q/ha). Yields of pulses are as low as 2.13 q/ha and 2.95 q/ha in puri and balasore respectively. Yield of oilseeds is as high as 10.39 q/ha in Cuttack, 8.19 q/ha in Mayurbhanj and 7.76 q/ha in puri. While in some districts it is as low as 1.88 q/ha in Phulbani, 3.24q/ha in Keonjhar and 3.41 q/ha in Sundergarh. To know the factors responsible for the inter-district production functions, we have employed frontier production function with time-invariant production function (Table 5.8). As expected all the variables included in the production function are having positive elasticities except cattle population. Rural literacy, Rural agricultural workers, number of tractors are significant positive coefficients with respective elasticieties of 0.70, 1.02, 0.095 respectively. The mean efficiency estimates have been given in Table 5.9. In terms of technical efficiency (%) the mean efficiency of districts is very low (only 36%), it indicates that without increasing input resources and with the existing technology districts gross value from agricultural sector can be increased by 64%. The highest efficiency has been showed by Phulbani(91%), followed by Sundergarh(63%) and Konjhar(61%). While lowest efficiency has been recorded in Ganjam(15%), Cuttack(11%) and Puri(19%), which are abundant in water. It may be due to inefficiency in use of water.


**Orissa District Map**

**Table 5.8. Results of Frontier Production Function (Time-invariant inefficiency model)**

| Dependent variable | Log of (Agricultural Value) produced in the district | |
|---|---|---|
| Number of obs | | 455 |
| Number of groups (district) | | 13 |
| Observations per district | | 35 |
| Wald | | 2382.43 |
| Prob > chi2 | | 0 |
| Log likelihood | | 100.04 |
| | Coef. | Std.Err. |
| ln_GIA | 0.0183 | 0.05 |
| ln_TOTCTL | -0.0957 | 0.09 |
| ln_NPK_Q | 0.0668 | 0.04 |
| ln_RAINL_1 | 0.0974 | 0.06 |
| ln_HYV | 0.1047 | 0.06 |
| ln_RURLIT | 0.7039** | 0.16 |
| ln_RURGAR | 1.0221** | 0.35 |
| ln_LROAD | 0.0463 | 0.09 |
| ln_TRACTOR | 0.0951 | 0.31 |
| cereal_a | 0.5148** | 0.06 |
| pulse_a | 0.1007** | 0.03 |
| oil_a | 0.0195 | 0.02 |
| _cons | -2.8678** | 1.4 |
| /mu | 1.1277** | 0.34 |
| /1nsigma2 | -0.725 | 0.49 |
| /ilgtgamma | 1.6377** | 0.59 |
| Sigma2 | 0.4842** | 0.24 |
| Gamma | 0.8372** | 0.08 |
| Sigma_u2 | 0.4054 | 0.24 |
| Sigma_v2 | 0.0788** | 0.01 |

**Crop Diversification & Benefits**

In Orissa, Kharif Paddy is grown on all types of lands irrespective of its suitability. Paddy grown on high lands under rainfed conditions is most vulnerable to moisture stress, leading to drastic yield reduction in years of poor rainfall. It is therefore necessary to diversify this area. The extent of high land paddy in the state is about 10.37 lakh ha. It was programmed to divert 4.89 lakh ha. of this high land paddy to non- paddy crops like pulses, oilseeds, cotton and vegetables during Kharif season.

**Table 5.9: Mean efficiency estimates of districts in Orissa**

| Districts | Mean efficiency |
|---|---|
| Balasore | 0.24 |
| Bolangir | 0.39 |
| Cuttack | 0.11 |
| Dhenkanal | 0.32 |
| Ganjam | 0.15 |
| Kalahandi | 0.39 |
| Keonjhar | 0.61 |
| Koraput | 0.21 |
| Mayurbhanj | 0.33 |
| Phulbani | 0.91 |
| Puri | 0.19 |
| Sambalpur | 0.20 |
| Sundergarh | 0.62 |
| Total: | 0.36 |

Recently cultivation of commercial crops likes sugarcane, jute, mesta, cotton, soyabean, groundnut, potato, chilly and onion etc. encouraged by the state government. In low rainfed areas of Kalahandi, Koraput, Nabarangpur and Rayagada, cotton cultivation is given more attention. In the coastal districts, riverbed potato cultivation is being promoted by providing certified potato seeds and other inputs. Progress in crop diversification due to diversion of kharif paddy area to non-paddy crops has been presented in Table 5.10.

**Table 5.10. Rice area diverted to non-rice area (hectares) during kharif season in ha**

| Sl.No. | Crop | 2005 | 2006 | 2007 |
|---|---|---|---|---|
| 1 | Cereals | 16693 | 18188 | 18206 |
| 2 | Pulses | 31698 | 35741 | 56585 |
| 3 | Oilseeds | 15093 | 9105 | 25423 |
| 4 | Fibres | 14282 | 6687 | 3036 |
| 5 | Sugarcane | 12792 | 4244 | 5836 |
| 6 | Vegetables | 19109 | 15005 | 33577 |
| 7 | Spices | 3124 | 2504 | 2533 |
| 8 | Horticultural crops | 4518 | 2816 | 1210 |
| | Total | 117309 | 94290 | 146406 |

| **Table 5.11: Marketed Surplus elasticities of Crops in Orissa** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Paddy | Mung | Urad | Arhar | Groundnut | Sesamum | Nigerseed | Jute |
| Marketed surplus ratio | 0.650 | 0.510 | 0.600 | 0.740 | 0.890 | 0.740 | 0.940 | 0.950 |
| Consumption-marketed surplus ratio | 0.538 | 0.961 | 0.667 | 0.351 | 0.124 | 0.351 | 0.053 | 0.053 |
| Share of gross output in net income | 2.397 | 2.160 | 3.150 | 2.942 | 2.047 | 2.481 | 3.542 | 1.821 |
| Price elasticity of demand | -0.553 | -1.303 | -1.303 | -1.303 | -0.538 | -0.538 | -0.538 | -1.017 |
| Income elasticity of demand | 0.455 | 0.713 | 0.713 | 0.713 | 0.755 | 0.755 | 0.755 | 0.234 |
| Price elasticity of marketed surplus | -0.289 | -0.228 | -0.629 | -0.279 | -0.124 | -0.469 | -0.114 | 0.031 |
| Price effect on marketed surplus | 0.298 | 1.252 | 0.869 | 0.458 | 0.066 | 0.189 | 0.029 | 0.054 |
| Income effect on marketed surplus | -0.587 | -1.479 | -1.497 | -0.737 | -0.191 | -0.658 | -0.142 | -0.022 |
| Total effect | -0.289 | -0.228 | -0.629 | -0.279 | -0.124 | -0.469 | -0.114 | 0.031 |

Elasticities of marketed surplus ratios have been calculated and presented in Table 5.11. Marketed surplus ratio (M/QP) is large for commercial crops like groundnut ((0.89), nigerseed (0.94), jute (0.95). For major staple crop paddy marketed surplus ratio is 0.65, while for pulse crops it rages from 0.51 for mung to 0.74 for arhar. The consumption to marketed surplus ratio (C/M) is higher for pulse crops with 0.96 for mung and 0.66 for Urad. For paddy consumption to marketed surplus ratio is hovering around 0.53. Consumption-marketed surplus ratios for oilseed crops are slightly lower at 0.12 for groundnut, 0.35 for sesamum and 0.053 for nigerseed. For pure commercial crop nigerseed it was 0.053. Share of gross output in net income (QP/I) ranges form 3.54 for nigerseed to 1.8 for jute. As expected price elasticity of demand is negative for all crops, which ranged from (-) 1.303 for pulse crops to (-) 0.538 for oilseed crops. While price elasticity of demand is (-) 0.553 for major staple crop paddy. As expected, income elasticity of demand is positive for all crops, which is ranged from 0.234 for jute to 0.755 oilseed crops, while it is hovering around 0.713 for pulse crops, and for paddy it was 0.455.

The price elasticity of marketed surplus is positive for jute with 0.031, while for all other crops it was negative. It ranges from highest for (-) 0.629 for urad, followed by (-) 0.469 for sesamum, (-) 0.289 for paddy, (-) 0.279 for arhar, (-) 0.228 for mung, (-) 0.124 for groundnut and (-) 0.114 for nigerseed. Further, price elasticity of marketed surplus is decomposed into price effect on marketed surplus and income effect on marketed surplus. As expected price effect on marketed surplus is positive for all crops due to positive price supply response, which is highest for mung with 1.252, followed by 0.869 for urad and arhar (0.458), while income effect on marketed surplus is negative. As income increase subsistence farmers retained more quantity for self-consumption and hence marketed surplus declined. The income effect dominates the price effect for all crops except jute. Hence with the crop price inflation on marketed surplus is negative for essential commodities in food basket of the subsistence farmers. Which indicates at least in the short-term (in the coming decade) as price of agricultural commodities increases, due to higher income effect, the marketed surplus will decrease. This leads to shortage of essntial commodities like pulses and oilseeds, as they are already short in supply than demand unless efforts are made in improve the TFP trend of these essential commodities.

Table 5.12 presented estimates of marketed surplus for paddy, cereals, pulses and oilseeds from 2001-2 to 2006-7. Which also reveals the fact that, in year 2002-03,

Orissa suffered from serious shortage of all agricultural commodities including major staple paddy. However, marketed surplus increased afterwards for all crops, but it is still a large negative for oilseed crop. Which indicates that there is a need for large scale diversification from paddy to non-paddy crops especially for oilseeds in terms of food security point of view.

Keeping this in view we have calculated elasticities and marginal effects from one ha shift in area from the existing cropping pattern to cereals, pulses and oilseeds and presented in table 4.10. These figures indicate that, area elasticity of agricultural value is 0.515 for cereals, 0.101 for pulses and 0.02 for oilseeds. The marginal effect due to shift in area from the existing land allocation to cereals, pulses and oilseeds on agricultural value per hectare is found to be Rs.404.8, Rs.983.3 and Rs.582.7 Table 5.13). which indicates that there is not only gains in terms of food security at macro-level, there is direct benefit to farmers in terms of increase in gross value in shifting to pulses and oilseeds.

**Table 5.12. Estimates of Marketable Surplus of Rice, Cereals, Pulses and Oilseeds from 2001-02 to 2006-7**

| Year | Projected Population (lakh) | Adult Equivalent (Laks) 88% | Total Consumption Requirement (Lakh tons) | Total Requirement (including seed, feed & wastage) (lakh tones) | Production (lakh tones) | Surplus/ deficit (lakh tones) |
|---|---|---|---|---|---|---|
| Requirement 400 gms per adult per day(Rice) | | | | | | |
| 2001-02 | 371.03 | 326.51 | 47.7 | 54.34 | 71.48 | 17.14 |
| **2002-03** | **377.06** | **331.81** | **48.4** | **55.23** | **32.44** | **-22.79** |
| 2003-04 | 383.19 | 337.21 | 49.2 | 56.12 | 67.34 | 11.22 |
| 2004-05 | 389.41 | 342.68 | 50.0 | 57.04 | 65.37 | 8.33 |
| 2005-06 | 395.74 | 348.25 | 50.8 | 57.96 | 69.63 | 11.67 |
| 2006-07 | 402.16 | 353.90 | 51.7 | 58.90 | 69.28 | 10.38 |
| Requirement 500 gms per adult per day(Cereals) | | | | | | |
| 2001-02 | 371.03 | 326.51 | 59.6 | 68.53 | 75.36 | 6.83 |
| **2002-03** | **377.06** | **331.81** | **60.6** | **69.64** | **35.86** | **-33.78** |
| 2003-04 | 383.19 | 337.21 | 61.5 | 70.77 | 71.14 | 0.37 |
| 2004-05 | 389.41 | 342.68 | 62.5 | 71.92 | 69.64 | -2.28 |
| 2005-06 | 395.74 | 348.25 | 63.6 | 73.09 | 74.26 | 1.17 |
| 2006-07 | 402.16 | 353.90 | 64.6 | 74.27 | 74.32 | 0.05 |
| Requirement 50 gms per adult per day(Pulses) | | | | | | |
| 2001-02 | 371.03 | 326.51 | 8.46 | 9.67 | 6.97 | -2.70 |
| **2002-03** | **377.06** | **331.81** | **8.60** | **9.83** | **4.58** | **-5.25** |
| 2003-04 | 383.19 | 337.21 | 8.74 | 9.99 | 6.23 | -3.76 |
| 2004-05 | 389.41 | 342.68 | 8.88 | 10.15 | 6.25 | -3.90 |
| 2005-06 | 395.74 | 348.25 | 9.02 | 10.32 | 7.94 | -2.38 |
| 2006-07 | 402.16 | 353.90 | 9.17 | 10.48 | 8.66 | -1.82 |
| Requirement 45 gms of oil per adult per day(Oilseeds) | | | | | | |
| 2001-02 | 371.03 | 326.51 | 16.24 | 18.52 | 5.40 | -13.12 |
| 2002-03 | 377.06 | 331.81 | 16.51 | 18.82 | 3.23 | -15.59 |
| 2003-04 | 383.19 | 337.21 | 16.78 | 19.13 | 4.98 | -14.15 |
| 2004-05 | 389.41 | 342.68 | 17.05 | 19.45 | 5.28 | -14.17 |
| 2005-06 | 395.74 | 348.25 | 17.33 | 19.76 | 5.51 | -14.25 |
| 2006-07 | 402.16 | 353.90 | 17.61 | 20.09 | 6.00 | -14.09 |

Source: Department of Agriculture, Orissa

**Table 5.13. Marginal effects on increase in gross revenue from a one hectare increase in area in different districts (average for 2001-2005)**

| District | Agril. Value (1000 Rs.) | Cereal Area (1000 ha) | Pulses Area (000 ha) | Oils Seeds (000 ha) | Elasticity | | | Marginal increase in Gross Revenue Rs. per ha | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cereal | Pulses | Oilseeds | Cereal | Pulses | Oilseeds |
| Balasore | 355568.2 | 405.6 | 5.9 | 4.8 | 0.515 | 0.101 | 0.02 | 451.5 | 6086.8 | 1481.5 |
| Bolangir | 248854.3 | 346.5 | 25.4 | 15.6 | 0.515 | 0.101 | 0.02 | 369.9 | 989.5 | 319 |
| Cuttack | 346901.6 | 374.1 | 69 | 8.1 | 0.515 | 0.101 | 0.02 | 477.6 | 507.8 | 856.5 |
| Dhenkanal | 215555.9 | 291.2 | 18.4 | 11 | 0.515 | 0.101 | 0.02 | 381.2 | 1183.2 | 391.9 |
| Ganjam | 310766 | 326.3 | 66.2 | 10.1 | 0.515 | 0.101 | 0.02 | 490.5 | 474.1 | 615.4 |
| Kalahandi | 291135.5 | 382.6 | 41.1 | 5.5 | 0.515 | 0.101 | 0.02 | 391.9 | 715.4 | 1058.7 |
| Keonjhar | 143663.5 | 215.2 | 10.6 | 1.8 | 0.515 | 0.101 | 0.02 | 343.8 | 1368.9 | 1596.3 |
| Koraput | 437070.4 | 581.5 | 34.5 | 17.5 | 0.515 | 0.101 | 0.02 | 387.1 | 1279.5 | 499.5 |
| Mayurbhanj | 231297.8 | 334 | 10.6 | 3.2 | 0.515 | 0.101 | 0.02 | 356.6 | 2203.9 | 1445.6 |
| Phulbani | 115616 | 134 | 11.8 | 5.4 | 0.515 | 0.101 | 0.02 | 444.3 | 989.6 | 428.2 |
| Puri | 286388.3 | 380.7 | 46.6 | 6.3 | 0.515 | 0.101 | 0.02 | 387.4 | 620.7 | 909.2 |
| Sambalpur | 486149.9 | 552.9 | 20.7 | 29.4 | 0.515 | 0.101 | 0.02 | 452.8 | 2372 | 330.7 |
| Sundergarh | 117489.7 | 237.8 | 7.6 | 4.4 | 0.515 | 0.101 | 0.02 | 254.4 | 1561.4 | 534 |
| Orissa | 3586457 | 4562.4 | 368.4 | 123.1 | 0.515 | 0.101 | 0.02 | 404.8 | 983.3 | 582.7 |

Source: Authors calculations

## Chapter-VI

## Conclusion and Policy Implication

Over the last three decades there has been stagnation in agriculture in Orissa. From early 1970s to late 1990s the growth rates food grains in area, yield rate and production are found to be 0.54, 1.34 and 1.88 respectively. During the period 1996 to 2003 the growth rate is negative in area, production and yield for all major crops. Only after 2003 there is some positive growth rates seen in Orissa agricultural sector. These growth rates particularly up to 2003 are much lower in comparison to other Indian states and all-India average. It shows that in production of oilseeds and pulses Orissa recorded a negative growth rate, while in production of food grains it recorded positive growth, mainly because of increase in area under food grains, especially paddy crop. It also indicates that, during the last decade there is an increase in concentration in Orissa agrarian economy towards paddy with significant decline in area under other crops particularly oilseed crops. The TFP growth rates also shows that except paddy, groundnut and jute, all other crops recorded negative growth. It may be due to the increase in real cost of production and relative decline in price of output. If this stagnate and negative growth in TFP continues, already food deficit state will see further increase in shortage of food crops, especially pulses and oilseeds if not paddy. There is an urgent need to increase TFP growth in all crops especially in pulses and oilseeds to make their cultivation profitable and to increase crop diversification and optimal utilization of land and water resources. It was observed that there is inverse relationship between TFP growth and real cost of production among all the crops. It is necessary to reduce the real cost of production to arrest decline in TFP growth rate in Orissa agriculture. Partial productivity of land and labour increased significantly due to the increased use of modern inputs per unit of labour and land, while partial productivity of fertilizer declined for all the crops due to increased dosage of fertilizers in recent years and unbalanced use of fertilizers.

Any future projection for agricultural development of the state has to take into account the population growth and its food requirement. The population of Orissa, which was 367.07 lakh in 2001. Based on the projected growth rate it is estimated that population would be 424.60 lakh in 2021. Based on the projected demand and supply, Orissa will be surplus in cereals especially in paddy production, while projected pulses demand is 11.1 lakh tones, with a shortage of 2.4 lakh tones, while projected demand for oilseeds is 21.2 lakh tones, with a shortage of 15.2 lakh tones. These figures indicates that, Orissa

Comment [A1]:

Comment [A2]:

Comment [A3]:

needs to increase significantly its area under both pulses and oilseeds in the long run to make it self-sufficient and to increase food and nutrition security.

As study indicates the TFP growth of all crops, except paddy, groundnut and jute has declined with negative growth. Concentration of cropped area is increased in paddy cultivation. With consequent adverse effects on gross irrigated area and cropping intensity, as paddy is a water intensive crop. For achieving the desired level of food production keeping in mind the dietary requirement, we need to raise GCA and cropping intensity, which, in turn, depends on increase in crop diversification towards pulses and oilseeds. The results also shows that there is significant monetary benefits to farmers through crop diversification to pulses and oilseeds, in addition to food security.

The results also reveal the fact that, in year 2002-03, Orissa suffered from serious shortage of all agricultural commodities including major staple paddy. However, marketed surplus increased afterwards for all crops, but it is still a large negative for oilseed crop. Which indicates that there is a need for large-scale diversification from paddy to non-paddy crops especially for oilseeds in terms of food and nutrition security point of view.

Keeping this in view we have calculated elasticities and marginal effects from a one ha shift in area from the existing cropping pattern to cereals, pulses and oilseeds. These figures indicate that, area elasticity of agricultural value is 0.515 for cereals, 0.101 for pulses and 0.02 for oilseeds. The marginal effect due to shift in area from the existing land allocation to cereals, pulses and oilseeds on agricultural value per hectare is found to be Rs.404.8, Rs.983.3 and Rs.582.7. Which indicates that there is not only gains in terms of food security at macro-level, there is direct benefit to farmers in terms of increase in gross value in shifting to pulses and oilseeds.

To sustain the agricultural production, we need enhanced supply of inputs like seed, fertilizer and pesticides and irrigated area. Seed replacement ratio is less than 20% for most of the crops, which needs to be increased by development of innovative supply chains for certified seed. Total seed supplied for all crops in 2005-06 is 62, 000 tonnes, projected demand for seed is 72, 568 tonnes for 2011-12. Likewise fertilizer consumption per ha. of GCA was 70 kg for year 2005-06, projected to increase further to 134 kg for the year 2011-12. Infrastructure items such as farm energy and power, agricultural credit, marketing, warehousing and extension support need to be developed

concurrently to sustain agricultural growth at desired level. Based on performance of banking sector, credit supply in the year 2001-02 is Rs.2100.16 crore rupees, and projected credit demand is Rs. 5906.82 crore rupees for 2011-12. To bridge this increase in credit demand, wide network of bank branches and also micro-finance network needs to be build up.

Literacy rate, % agricultural workers, irrigation, electricity used for agricultural purpose, marketing infrastructure and transport facilities are crucial for increasing agricultural value from districts. Steps to be taken to improve conditions in the above aspects. Efficiency level at district level is very low only at 36%. Which indicates that, with the existing resources and technology, districts agricultural value product can be increased by 64% with proper adjustment and operationalisation of best practices.

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| Appendix Table1. Use of inputs per ha by crops in orissa | | | | | | |
|---|---|---|---|---|---|---|
| CROP | YEAR | Seed | Human labour | Bullock labour | FYM | Fertiliser |
| | | kg/ha | hrs/ha | hrs/ha | q/ha | kg/ha |
| Paddy | 1974-80 | 92.39 | 941.83 | 231.17 | 25.93 | 15.04 |
| | 1981-90 | 89.26 | 1034.76 | 274.36 | 26.18 | 33.47 |
| | 1991-00 | 91.51 | 1069.32 | 221.79 | 22.48 | 64.48 |
| | 2001-03 | 91.27 | 1095.09 | 186.49 | 24.47 | 90.27 |
| | Growth | 0.03 | 0.67 | -0.79 | -0.77 | 7.85 |
| | | | | | | |
| Mung | 1981-90 | 29.96 | 350.89 | 122.61 | 1.24 | 1.19 |
| | 1991-00 | 28.88 | 333.26 | 99.38 | 0.65 | 0.60 |
| | 2001-03 | 29.64 | 349.00 | 94.90 | 0.98 | 1.28 |
| | Growth | -0.20 | -0.04 | -1.44 | -2.83 | 2.54 |
| | | | | | | |
| Urad | 1984-90 | 31.70 | 347.55 | 101.95 | 2.02 | 1.66 |
| | 1991-00 | 31.93 | 402.73 | 100.05 | 1.05 | 1.67 |
| | 2001-03 | 32.21 | 380.51 | 84.77 | 1.38 | 0.97 |
| | Growth | 0.07 | 0.75 | -1.19 | -7.30 | -7.91 |
| | | | | | | |
| Arhar | 1994-00 | 22.79 | 489.05 | 139.00 | 0.77 | 0.89 |
| | 2001-03 | 22.61 | 428.93 | 124.77 | 0.24 | 0.98 |
| | Growth | -0.17 | -3.19 | -0.09 | -11.09 | 1.85 |
| | | | | | | |
| Groundnut | 1975-80 | 111.73 | 1097.11 | 201.23 | 12.58 | 17.95 |
| | 1081-90 | 121.90 | 1067.03 | 197.66 | 13.47 | 32.55 |
| | 1991-98 | 125.97 | 922.55 | 197.14 | 19.71 | 57.61 |
| | Growth | 0.73 | -1.95 | -0.14 | 2.76 | 6.74 |
| | | | | | | |
| Sesamum | 1997-2000 | 10.65 | 476.54 | 133.60 | 0.13 | 0.71 |
| | 2001-03 | 10.25 | 418.94 | 142.62 | 0.00 | 0.57 |
| | Growth | -1.06 | -2.92 | 1.51 | 7.43 | 6.60 |
| | | | | | | |
| Nigerseed | 1997-00 | 10.84 | 320.81 | 143.34 | 2.22 | 0.00 |
| | 2001-03 | 10.62 | 287.41 | 136.07 | 0.00 | 0.00 |
| | Growth | -1.03 | -3.14 | -2.30 | -26.62 | 0.00 |
| | | | | | | |
| Jute | 1973-80 | 9.49 | 1471.32 | 182.62 | 24.84 | 16.07 |
| | 1981-90 | 8.20 | 1505.47 | 176.49 | 21.14 | 40.96 |
| | 1991-96 | 7.64 | 1467.91 | 119.46 | 23.30 | 43.53 |
| | Growth | -1.21 | 0.01 | -2.16 | 0.17 | 6.86 |

| Appendix Table 2: Index of input used in crops, Orissa | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CROP | YEAR | Seed | Human Labour | Bullock labour | Machine labour | FYM | NPK | Irrigation | Plant protection | Traditional | Modern inputs |
| Paddy | 1974-80 | 107.8 | 120.1 | 130.3 | 100.4 | 78.6 | 115.7 | 58.4 | 36.1 | 108.6 | 95.4 |
| | 1981-90 | 104.2 | 131.9 | 154.7 | 151.2 | 79.3 | 257.5 | 49.7 | 25.5 | 119.0 | 168.1 |
| | 1991-00 | 106.8 | 136.3 | 125.0 | 342.4 | 68.1 | 496.0 | 63.9 | 52.3 | 133.2 | 365.1 |
| | 2001-03 | 106.5 | 139.6 | 105.1 | 565.0 | 74.2 | 694.4 | 120.6 | 144.5 | 137.0 | 548.3 |
| | Growth | 0.03 | 0.67 | -0.79 | 6.75 | -0.77 | 7.85 | 2.06 | 6.35 | 1.05 | 7.39 |
| Mung | 1981-90 | 99.5 | 108.4 | 105.2 | 100.2 | 772.9 | 3951.8 | 67.1 | 21.1 | 89.6 | 95.1 |
| | 1991-00 | 95.9 | 102.9 | 85.3 | 102.7 | 407.3 | 2000.0 | 52.8 | 9.3 | 43.0 | 44.7 |
| | 2001-03 | 98.5 | 107.8 | 81.5 | 249.9 | 614.6 | 4277.8 | 153.0 | 95.2 | 22.0 | 50.7 |
| | Growth | -0.20 | -0.04 | -1.44 | 2.46 | -9.49 | 2.54 | -1.18 | 1.37 | -7.18 | -5.29 |
| Urad | 1984-90 | 99.8 | 102.0 | 95.1 | 119.2 | 121.9 | 168.1 | 21.4 | 87.9 | 116.1 | 132.4 |
| | 1991-00 | 100.5 | 118.2 | 93.3 | 158.4 | 63.3 | 168.5 | 32.8 | 29.7 | 58.9 | 78.5 |
| | 2001-03 | 101.4 | 111.7 | 79.0 | 260.3 | 83.3 | 97.6 | 67.4 | 3.3 | 32.0 | 57.3 |
| | Growth | 0.07 | 0.75 | -1.19 | 3.09 | -7.30 | -7.91 | 4.08 | -24.00 | -9.79 | -8.92 |
| Arhar | 1994-00 | 91.7 | 81.4 | 130.4 | 54.8 | 26.5 | 35.6 | 0.0 | 0.0 | 86.9 | 50.7 |
| | 2001-03 | 91.0 | 71.4 | 117.1 | 77.2 | 8.3 | 39.4 | 0.0 | 0.0 | 68.3 | 54.7 |
| | Growth | -0.17 | -3.19 | -0.09 | 2.55 | -8.94 | 4.09 | 0.00 | 0.00 | -3.41 | -0.91 |
| Groundnut | 1975-80 | 103.8 | 84.5 | 99.2 | 104.1 | 62.4 | 94.8 | 16.7 | 16.7 | 116.7 | 122.0 |
| | 1081-90 | 113.2 | 82.2 | 97.5 | 141.4 | 66.8 | 172.0 | 15.5 | 34.7 | 287.7 | 499.8 |
| | 1991-98 | 117.0 | 71.1 | 97.2 | 199.8 | 97.8 | 304.3 | 225.0 | 273.2 | 115.0 | 333.3 |
| | Growth | 0.73 | -1.95 | -0.14 | 3.60 | 2.76 | 6.74 | 26.22 | 25.87 | -1.56 | 4.47 |
| Sesamum | 1997-2000 | 235.8 | 100.2 | 95.2 | 0.0 | 89.6 | 25.0 | 0.0 | 94.1 | 83.3 | 86.0 |
| | 2001-03 | 190.0 | 107.0 | 135.7 | 0.0 | 165.1 | 0.0 | 0.0 | 90.6 | 69.0 | 104.7 |
| | Growth | 48.10 | 1.51 | 10.38 | 0.00 | 14.98 | -49.34 | 0.00 | -1.06 | -6.12 | 6.27 |
| Nigerseed | 1997-00 | 0.0 | 91.6 | 100.5 | 0.0 | 88.0 | 50.0 | 0.0 | 94.1 | 78.3 | 80.3 |
| | 2001-03 | 0.0 | 87.0 | 129.3 | 0.0 | 92.5 | 0.0 | 0.0 | 92.2 | 68.0 | 95.3 |
| | Growth | 0.00 | -2.30 | 7.05 | 0.00 | 1.85 | -64.38 | 0.00 | -1.03 | -6.53 | 2.14 |
| Jute | 1973-80 | 185.2 | 95.8 | 96.5 | 32.1 | 244.2 | 169.1 | 54.9 | 78.1 | 92.1 | 128.0 |
| | 1981-90 | 471.9 | 92.6 | 110.2 | 112.5 | 466.2 | 143.9 | 2.3 | 67.4 | 88.1 | 221.5 |
| | 1991-96 | 501.4 | 62.7 | 215.6 | 30.7 | 1126.7 | 158.6 | 3.1 | 62.8 | 38.3 | 144.8 |
| | Growth | 6.86 | -2.16 | 4.30 | 1.95 | 9.48 | 0.17 | -11.30 | -1.21 | -5.34 | 0.58 |

| Appendix Table 3: Input share in total cost by crops in Orissa | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| CROP | YEAR | SHL | SBL | SML | SSEED | SFERT | SFYM | SIRR | SPP | SRVOL | SINT | TC |
| Paddy | 1974-80 | 0.30 | 0.14 | 0.02 | 0.07 | 0.05 | 0.06 | 0.00 | 0.01 | 0.30 | 0.06 | 1426.94 |
| | 1981-90 | 0.33 | 0.12 | 0.02 | 0.05 | 0.05 | 0.05 | 0.01 | 0.00 | 0.30 | 0.06 | 3393.87 |
| | 1991-00 | 0.36 | 0.10 | 0.03 | 0.04 | 0.06 | 0.04 | 0.00 | 0.00 | 0.29 | 0.06 | 10448.78 |
| | 2001-03 | 0.39 | 0.13 | 0.04 | 0.03 | 0.07 | 0.03 | 0.01 | 0.01 | 0.23 | 0.07 | 17034.78 |
| | Growth | 1.13 | -0.90 | 3.39 | -2.98 | 1.87 | -2.05 | -0.51 | 1.78 | -0.81 | 0.71 | 10.36 |
| Mung | 1981-90 | 0.25 | 0.12 | 0.05 | 0.13 | 0.01 | 0.00 | 0.00 | 0.00 | 0.32 | 0.11 | 1393.76 |
| | 1991-00 | 0.32 | 0.12 | 0.04 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.08 | 3786.20 |
| | 2001-03 | 0.33 | 0.17 | 0.07 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.09 | 6279.24 |
| | Growth | 2.08 | 1.28 | -0.87 | -0.81 | -3.39 | 2.61 | -4.81 | 17.68 | -1.53 | -2.33 | 9.44 |
| Urad | 1984-90 | 0.26 | 0.10 | 0.04 | 0.11 | 0.01 | 0.01 | 0.00 | 0.01 | 0.38 | 0.08 | 1614.14 |
| | 1991-00 | 0.32 | 0.11 | 0.04 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.08 | 4196.89 |
| | 2001-03 | 0.36 | 0.14 | 0.06 | 0.10 | 0.00 | 0.01 | 0.00 | 0.00 | 0.25 | 0.08 | 6267.61 |
| | Growth | 2.27 | 1.82 | -0.45 | -0.15 | -8.94 | -7.43 | 8.34 | -14.22 | -2.29 | -0.50 | 9.54 |
| Arhar | 1994-00 | 0.34 | 0.15 | 0.04 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.29 | 0.10 | 5181.25 |
| | 2001-03 | 0.35 | 0.17 | 0.05 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.12 | 6646.77 |
| | Growth | 0.19 | 5.70 | 1.59 | -2.73 | -13.27 | -9.04 | 0.00 | 0.00 | -3.42 | 2.28 | 4.85 |
| Groundnut | 1975-80 | 0.30 | 0.09 | 0.02 | 0.20 | 0.05 | 0.02 | 0.00 | 0.00 | 0.28 | 0.05 | 1771.07 |
| | 1081-90 | 0.27 | 0.07 | 0.02 | 0.18 | 0.04 | 0.02 | 0.00 | 0.00 | 0.36 | 0.05 | 4165.11 |
| | 1991-98 | 0.30 | 0.07 | 0.02 | 0.16 | 0.05 | 0.03 | 0.00 | 0.00 | 0.32 | 0.04 | 10694.51 |
| | Growth | 0.09 | -1.29 | 0.48 | -1.20 | 1.28 | 1.77 | -26.33 | -31.70 | 0.49 | -0.71 | 10.40 |
| Sesamum | 1997-2000 | 0.41 | 0.17 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.07 | 4929.70 |
| | 2001-03 | 0.39 | 0.20 | 0.03 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.11 | 5972.84 |
| | Growth | -1.79 | 5.10 | 7.64 | -2.63 | -44.81 | -70.04 | 0.00 | 0.00 | -5.13 | 9.65 | 5.43 |
| Nigerseed | 1997-00 | 0.35 | 0.20 | 0.03 | 0.04 | 0.00 | 0.01 | 0.00 | 0.00 | 0.31 | 0.07 | 4753.84 |
| | 2001-03 | 0.24 | 0.21 | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.44 | 0.05 | 5272.96 |
| | Growth | -8.55 | 1.77 | -1.63 | -10.68 | 0.00 | 97.81 | 0.00 | 0.00 | 9.32 | -9.43 | 5.56 |
| Jute | 1973-80 | 0.39 | 0.12 | 0.02 | 0.02 | 0.04 | 0.06 | 0.00 | 0.00 | 0.31 | 0.06 | 1704.91 |
| | 1981-90 | 0.40 | 0.09 | 0.02 | 0.02 | 0.05 | 0.03 | 0.00 | 0.00 | 0.35 | 0.04 | 4364.88 |
| | 1991-96 | 0.45 | 0.06 | 0.02 | 0.02 | 0.04 | 0.03 | 0.00 | 0.00 | 0.33 | 0.04 | 9994.03 |
| | Growth | 0.73 | -4.08 | 1.77 | -0.63 | 1.28 | -3.72 | 3.60 | 18.37 | 0.55 | -0.99 | 10.52 |

| Appendix Table 4: Index of input and output prices of crops in Orissa | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CROP** | **YEAR** | **IPHL** | **IPBL** | **IPSEED** | **IPFERT** | **IPFYM** | **IPIRR** | **IPML** | **IPPP** | **IPINT** | **IRVOL** | **IPINPUT** | **IPRICE** |
| Paddy | 1974-80 | 142.1 | 163.4 | 141.1 | 92.9 | 141.1 | 130.5 | 136.8 | 122.7 | 105.2 | 114.0 | 128.9 | 92.7 |
| | 1981-90 | 342.0 | 285.6 | 255.7 | 115.0 | 295.5 | 349.0 | 287.6 | 234.9 | 101.0 | 270.9 | 276.1 | 164.5 |
| | 1991-00 | 1120.4 | 958.3 | 594.3 | 212.6 | 1242.3 | 664.4 | 557.5 | 411.9 | 100.2 | 786.3 | 816.3 | 386.9 |
| | 2001-03 | 1893.1 | 2265.1 | 802.9 | 268.7 | 1040.4 | 866.4 | 722.0 | 478.8 | 98.4 | 1029.1 | 1291.7 | 442.3 |
| | Growth | 10.82 | 10.25 | 7.35 | 4.37 | 9.08 | 7.79 | 6.99 | 5.78 | -0.29 | 9.54 | 9.62 | 6.97 |
| Mung | 1981-90 | 178.2 | 113.5 | 149.5 | 18.6 | 121.4 | 129.4 | 140.4 | 133.3 | 92.6 | 155.7 | 148.6 | 156.0 |
| | 1991-00 | 633.5 | 386.2 | 414.0 | 19.0 | 357.1 | 246.4 | 272.1 | 233.8 | 91.9 | 383.8 | 415.3 | 424.9 |
| | 2001-03 | 1038.5 | 920.4 | 543.1 | 28.7 | 752.8 | 321.4 | 352.4 | 271.9 | 90.2 | 491.2 | 667.7 | 536.8 |
| | Growth | 11.57 | 12.17 | 8.84 | 3.51 | 9.01 | 5.82 | 6.13 | 4.77 | -0.31 | 7.92 | 9.53 | 8.84 |
| Urad | 1984-90 | 135.7 | 141.5 | 118.1 | 106.9 | 107.4 | 116.3 | 118.7 | 114.8 | 98.8 | 124.6 | 127.3 | 128.8 |
| | 1991-00 | 372.6 | 404.6 | 318.4 | 230.6 | 263.4 | 206.1 | 210.1 | 188.3 | 100.2 | 280.7 | 315.0 | 332.8 |
| | 2001-03 | 661.1 | 925.2 | 402.3 | 357.1 | 424.2 | 268.8 | 272.2 | 218.9 | 98.4 | 328.2 | 476.7 | 376.7 |
| | Growth | 11.00 | 12.49 | 9.26 | 8.45 | 9.36 | 5.82 | 5.95 | 4.58 | -0.16 | 7.19 | 9.30 | 8.52 |
| Arhar | 1994-00 | 130.5 | 143.5 | 107.7 | 116.7 | 159.9 | 114.8 | 121.5 | 91.3 | 97.3 | 115.0 | 116.7 | 119.3 |
| | 2001-03 | 192.0 | 221.6 | 120.8 | 63.9 | 214.0 | 137.1 | 142.5 | 98.9 | 99.3 | 123.7 | 157.3 | 129.0 |
| | Growth | 8.26 | 10.67 | 2.33 | -6.36 | 10.31 | 3.79 | 3.92 | 0.87 | -0.17 | 1.46 | 6.07 | 1.32 |

| Appendix Table 4: Index of input and output prices of crops in Orissa Cont.. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CROP** | **YEAR** | **IPHL** | **IPBL** | **IPSEED** | **IPFERT** | **IPFYM** | **IPIRR** | **IPML** | **IPPP** | **IPINT** | **IRVOL** | **IPINPUT** | **IPRICE** |
| Groundnut | 1975-80 | 125.6 | 125.2 | 114.1 | 104.0 | 142.8 | 127.2 | 113.1 | 117.0 | 106.0 | 111.0 | 118.2 | 143.9 |
| | 1081-90 | 267.8 | 238.5 | 215.8 | 109.1 | 330.1 | 323.9 | 222.7 | 214.0 | 102.6 | 337.9 | 265.9 | 294.6 |
| | 1991-98 | 1729.3 | 621.6 | 508.9 | 246.8 | 745.6 | 592.4 | 416.7 | 374.9 | 102.3 | 780.9 | 749.1 | 638.5 |
| | Growth | 12.63 | 9.44 | 8.66 | 5.14 | 9.60 | 8.62 | 7.47 | 6.59 | -0.23 | 11.08 | 10.49 | 8.77 |
| Sesamum | 1997-2000 | 102.6 | 115.3 | 102.5 | 83.4 | 107.8 | 104.8 | 104.4 | 100.3 | 95.0 | 94.0 | 101.5 | 105.1 |
| | 2001-03 | 132.5 | 150.9 | 116.5 | 72.6 | 127.7 | 117.7 | 113.6 | 109.7 | 99.2 | 93.2 | 126.3 | 118.1 |
| | Growth | 6.46 | 8.92 | 3.77 | -5.34 | 4.88 | 3.29 | 2.60 | 2.30 | 0.81 | 0.21 | 6.23 | 3.68 |
| Nigerseed | 1997-00 | 132.3 | 141.6 | 106.7 | 0.0 | 173.9 | 104.8 | 104.4 | 100.3 | 95.0 | 153.8 | 134.0 | 109.4 |
| | 2001-03 | 147.9 | 224.8 | 112.0 | 0.0 | 229.8 | 117.7 | 113.6 | 109.7 | 99.2 | 316.6 | 204.0 | 125.4 |
| | Growth | 5.87 | 15.35 | 1.63 | 0.00 | 11.17 | 3.29 | 2.60 | 2.30 | 0.81 | 20.60 | 13.09 | 4.48 |
| Jute | 1973-80 | 173.8 | 204.4 | 213.0 | 116.1 | 162.3 | 187.3 | 163.7 | 175.2 | 112.7 | 130.1 | 154.5 | 122.3 |
| | 1981-90 | 451.1 | 404.6 | 611.5 | 166.1 | 283.2 | 534.3 | 363.3 | 355.9 | 110.0 | 379.0 | 372.2 | 241.4 |
| | 1991-96 | 1173.4 | 818.2 | 1335.4 | 294.9 | 477.0 | 907.5 | 614.8 | 597.8 | 113.5 | 847.2 | 868.8 | 545.7 |
| | Growth | 11.19 | 8.56 | 11.06 | 4.89 | 6.58 | 9.49 | 7.95 | 7.30 | 0.01 | 11.02 | 10.09 | 8.61 |

| Appendix Table 5 Price of inputs (Rs.) deflated by whole sale price index in Orissa | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **CROP** | **YEAR** | **RPFERT** | **RPHL** | **RPBL** | **RPML** | **RPLAB** | **RPPP** | **RPIRR** |
| Paddy | 1974-80 | 83.9 | 127.6 | 146.4 | 122.5 | 132.1 | 109.9 | 115.3 |
| | 1981-90 | 54.7 | 151.9 | 129.8 | 131.3 | 143.3 | 108.0 | 160.6 |
| | 1991-00 | 43.4 | 222.3 | 188.0 | 113.2 | 202.4 | 85.2 | 135.4 |
| | 2001-03 | 34.0 | 239.1 | 286.6 | 91.2 | 230.9 | 60.5 | 109.6 |
| | Growth | -3.44 | 3.00 | 2.43 | -0.83 | 2.54 | -2.04 | -0.03 |
| | | | | | | | | |
| Mung | 1981-90 | 16.6 | 130.5 | 84.2 | 105.2 | 109.9 | 100.6 | 97.8 |
| | 1991-00 | 6.3 | 205.4 | 122.9 | 90.7 | 162.5 | 79.4 | 82.4 |
| | 2001-03 | 6.0 | 215.5 | 191.6 | 73.1 | 192.8 | 56.4 | 66.7 |
| | Growth | -4.26 | 3.80 | 4.40 | -1.64 | 3.67 | -3.00 | -1.95 |
| | | | | | | | | |
| Urad | 1984-90 | 88.8 | 110.2 | 114.9 | 97.7 | 109.6 | 94.6 | 96.2 |
| | 1991-00 | 88.5 | 145.1 | 154.5 | 84.0 | 136.8 | 76.7 | 82.7 |
| | 2001-03 | 89.6 | 164.1 | 231.9 | 67.7 | 163.5 | 54.4 | 66.9 |
| | Growth | 0.54 | 3.08 | 4.58 | -1.96 | 2.90 | -3.33 | -2.09 |
| | | | | | | | | |
| Arhar | 1994-00 | 97.4 | 107.6 | 116.7 | 101.0 | 110.9 | 76.9 | 95.6 |
| | 2001-03 | 36.5 | 109.1 | 126.9 | 81.2 | 113.7 | 56.3 | 78.2 |
| | Growth | -13.46 | 1.16 | 3.58 | -3.17 | 1.76 | -6.22 | -3.31 |
| | | | | | | | | |
| Groundnut | 1975-80 | 96.8 | 115.0 | 115.0 | 103.6 | 115.0 | 107.0 | 114.6 |
| | 1081-90 | 53.7 | 126.1 | 112.5 | 107.3 | 121.6 | 103.8 | 157.2 |
| | 1991-98 | 55.5 | 375.9 | 137.9 | 93.8 | 260.4 | 85.4 | 133.8 |
| | Growth | -2.88 | 4.61 | 1.41 | -0.55 | 3.67 | -1.44 | 0.60 |
| | | | | | | | | |
| Sesamum | 1997-2000 | 76.4 | 92.6 | 103.3 | 94.2 | 95.7 | 90.7 | 94.5 |
| | 2001-03 | 48.8 | 88.7 | 100.5 | 76.1 | 91.1 | 73.5 | 79.0 |
| | Growth | -13.53 | -1.72 | 0.74 | -5.59 | -1.17 | -5.88 | -4.90 |
| | | | | | | | | |
| Nigerseed | 1997-00 | 0.0 | 117.8 | 126.1 | 94.2 | 119.4 | 90.7 | 94.5 |
| | 2001-03 | 0.0 | 99.6 | 149.3 | 76.1 | 115.1 | 73.5 | 79.0 |
| | Growth | 0.00 | -2.32 | 7.16 | -5.59 | 1.47 | -5.88 | -4.90 |
| | | | | | | | | |
| Jute | 1973-80 | 85.7 | 125.9 | 148.5 | 119.1 | 130.4 | 127.3 | 134.1 |
| | 1981-90 | 62.0 | 159.2 | 142.8 | 130.6 | 157.2 | 128.8 | 193.6 |
| | 1991-96 | 53.6 | 215.9 | 153.6 | 112.8 | 205.1 | 110.1 | 166.7 |
| | Growth | -3.06 | 3.24 | 0.61 | 0.00 | 2.78 | -0.65 | 1.53 |

| Annexure Table 6. Descriptive statistics of variables taken in efficiency frontier production function (District-wise) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period/ District | Agril. Value (Rs.00) | Rural Literates (000) | Total Agricultural Workers (000) | Length of Road (km) | Cereal Area (00 ha) | Pulses Area (00 ha) | Oils Seeds (00 ha) | Others Area (00 ha) | Fertilizer Consumption (tones) (N+1.2K+1.5K) | Cattle Population (00) | Tractor (00 numbers) | Rainfall (mm) | GIA (00 ha) |
| Balasore | | | | | | | | | | | | | |
| 1971-80 | 56254.8 | 649.9 | 194.8 | 1933.5 | 436.9 | 42.9 | 9.5 | 5.1 | 4732.9 | 915.8 | 4.2 | 1335.1 | 97.4 |
| 1981-90 | 105181.2 | 942.9 | 241.0 | 4145.0 | 399.3 | 91.7 | 32.4 | 6.3 | 13941.7 | 1128.9 | 13.2 | 1509.9 | 208.8 |
| 1991-2000 | 234448.0 | 1476.0 | 294.5 | 6105.0 | 406.7 | 53.9 | 12.0 | 4.1 | 44669.5 | 1061.9 | 43.7 | 1706.7 | 259.2 |
| 2001-04 | 355568.2 | 2014.8 | 336.7 | 9401.1 | 405.6 | 5.9 | 4.8 | 12.7 | 44284.8 | 970.0 | 134.9 | 1611.3 | 314.6 |
| Total | 163905.2 | 1164.6 | 256.8 | 4824.0 | 413.0 | 54.7 | 16.1 | 6.2 | 24424.7 | 1026.2 | 36.7 | 1530.7 | 206.5 |
| Bolangir | | | | | | | | | | | | | |
| 1971-80 | 44895.4 | 252.6 | 238.9 | 4018.4 | 320.0 | 59.9 | 24.5 | 8.1 | 4029.7 | 626.4 | 3.5 | 1050.8 | 95.0 |
| 1981-90 | 112309.0 | 377.3 | 277.5 | 8910.7 | 321.3 | 138.3 | 59.9 | 12.3 | 8569.2 | 976.6 | 13.2 | 1200.5 | 178.1 |
| 1991-2000 | 215106.8 | 603.7 | 315.5 | 11211.4 | 308.6 | 85.0 | 26.3 | 9.8 | 11909.8 | 907.9 | 26.1 | 1341.6 | 179.9 |
| 2001-04 | 248854.3 | 881.9 | 338.5 | 13757.7 | 346.5 | 25.4 | 15.6 | 2.2 | 16998.2 | 906.4 | 53.6 | 1337.5 | 182.2 |
| Total | 141925.3 | 478.5 | 286.1 | 8862.7 | 320.9 | 84.5 | 33.9 | 8.9 | 9430.8 | 846.9 | 19.9 | 1217.6 | 155.5 |
| Cuttack | | | | | | | | | | | | | |
| 1971-80 | 113139.4 | 1470.0 | 324.4 | 3232.7 | 643.0 | 246.8 | 49.9 | 11.2 | 14860.5 | 1556.6 | 4.9 | 1288.7 | 340.0 |
| 1981-90 | 246683.5 | 2100.9 | 389.8 | 7098.2 | 551.0 | 308.6 | 120.3 | 11.7 | 23469.4 | 1786.5 | 24.1 | 1438.7 | 523.8 |
| 1991-2000 | 315926.4 | 2532.1 | 399.4 | 13679.1 | 464.7 | 184.3 | 39.2 | 10.6 | 37664.5 | 1298.4 | 83.1 | 1538.7 | 524.6 |
| 2001-04 | 346901.6 | 2603.0 | 353.5 | 20445.1 | 374.1 | 69.0 | 8.1 | 7.7 | 26438.0 | 1295.0 | 213.6 | 1640.4 | 699.0 |
| Total | 242628.6 | 2115.6 | 368.7 | 9780.7 | 527.3 | 221.2 | 61.0 | 10.7 | 25489.5 | 1511.1 | 62.6 | 1453.2 | 496.6 |
| Dhenkanal | | | | | | | | | | | | | |
| 1971-80 | 47853.6 | 408.1 | 160.8 | 4307.9 | 330.3 | 77.2 | 37.1 | 6.3 | 2304.7 | 792.0 | 367.4 | 1192.9 | 53.7 |
| 1981-90 | 124599.7 | 601.1 | 195.4 | 9447.9 | 250.3 | 163.6 | 93.7 | 9.6 | 5812.1 | 958.2 | 459.0 | 1366.3 | 118.7 |
| 1991-2000 | 187239.0 | 894.3 | 231.0 | 13717.6 | 265.1 | 103.3 | 41.1 | 7.1 | 9964.7 | 892.2 | 494.3 | 1460.0 | 162.1 |
| 2001-04 | 215555.9 | 1250.7 | 257.3 | 18787.4 | 291.2 | 18.4 | 11.0 | 6.2 | 13609.9 | 999.8 | 528.0 | 1387.8 | 336.6 |
| Total | 133562.9 | 722.5 | 204.5 | 10533.5 | 283.3 | 101.0 | 50.7 | 7.4 | 7110.4 | 897.8 | 452.8 | 1346.6 | 143.7 |
| | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ganjam | | | | | | | | | | | | | |
| 1971-80 | 65399.5 | 521.3 | 421.3 | 4655.4 | 366.8 | 197.5 | 42.7 | 5.7 | 10811.0 | 1088.4 | 3.8 | 1212.8 | 241.6 |
| 1981-90 | 155539.8 | 738.6 | 494.1 | 10221.9 | 315.4 | 235.8 | 79.8 | 9.1 | 22912.3 | 1180.7 | 12.9 | 1286.0 | 341.8 |
| 1991-2000 | 264005.3 | 1111.8 | 578.6 | 14601.6 | 335.5 | 171.1 | 23.9 | 7.9 | 31781.3 | 1057.5 | 20.0 | 1316.2 | 306.8 |
| 2001-04 | 310766.0 | 1605.6 | 645.2 | 18717.6 | 326.3 | 66.2 | 10.1 | 5.8 | 48972.2 | 1163.7 | 27.2 | 1314.4 | 329.1 |
| Total | 182950.8 | 907.0 | 519.0 | 11096.5 | 337.4 | 182.2 | 43.3 | 7.3 | 25711.6 | 1116.7 | 14.4 | 1277.8 | 301.4 |
| Kalahandi | | | | | | | | | | | | | |
| 1971-80 | 42003.6 | 174.1 | 280.7 | 5288.4 | 302.0 | 114.7 | 34.5 | 9.7 | 500.4 | 707.7 | 3.5 | 1235.6 | 40.0 |
| 1981-90 | 91421.2 | 275.0 | 328.7 | 11612.1 | 315.4 | 203.5 | 65.3 | 9.2 | 2449.3 | 864.3 | 12.9 | 1324.3 | 87.8 |
| 1991-2000 | 215559.3 | 459.2 | 388.3 | 16201.6 | 361.8 | 155.9 | 24.2 | 13.1 | 12712.5 | 819.5 | 21.8 | 1559.9 | 148.0 |
| 2001-04 | 291135.5 | 704.5 | 435.2 | 20691.5 | 382.6 | 41.1 | 5.5 | 17.3 | 27968.0 | 835.4 | 27.2 | 1643.9 | 275.3 |
| Total | 141300.5 | 360.1 | 347.2 | 12413.7 | 334.4 | 141.3 | 36.3 | 11.6 | 8470.3 | 802.6 | 14.8 | 1411.9 | 118.1 |
| Keonjhar | | | | | | | | | | | | | |
| 1971-80 | 28565.6 | 219.3 | 148.4 | 1212.2 | 238.1 | 28.3 | 8.5 | 1.5 | 1052.5 | 558.5 | 2.5 | 1294.2 | 16.8 |
| 1981-90 | 52545.3 | 329.9 | 175.3 | 2661.4 | 221.1 | 65.0 | 23.1 | 2.1 | 3121.7 | 682.9 | 9.3 | 1565.5 | 64.6 |
| 1991-2000 | 104212.7 | 505.2 | 207.7 | 3805.0 | 204.1 | 34.1 | 9.5 | 1.2 | 6285.3 | 716.8 | 18.5 | 1363.9 | 110.1 |
| 2001-04 | 143663.5 | 723.1 | 233.2 | 4894.3 | 215.2 | 10.6 | 1.8 | 1.3 | 10184.7 | 621.0 | 26.0 | 1491.3 | 104.4 |
| Total | 73473.0 | 404.6 | 185.2 | 2893.1 | 220.2 | 37.9 | 12.0 | 1.5 | 4443.4 | 648.2 | 12.4 | 1419.8 | 69.6 |
| Koraput | | | | | | | | | | | | | |
| 1971-80 | 65122.8 | 198.6 | 472.5 | 4783.2 | 425.4 | 93.9 | 32.4 | 11.1 | 2580.3 | 1400.9 | 37.6 | 1371.3 | 45.4 |
| 1981-90 | 136699.2 | 315.0 | 573.8 | 10502.7 | 396.5 | 157.9 | 52.4 | 15.2 | 7480.3 | 1409.0 | 70.2 | 1377.2 | 127.9 |
| 1991-2000 | 345099.3 | 522.3 | 682.1 | 21501.7 | 494.9 | 107.2 | 36.9 | 17.2 | 19759.2 | 1639.1 | 79.5 | 2099.7 | 310.7 |
| 2001-04 | 437070.4 | 862.8 | 762.6 | 37317.4 | 581.5 | 34.5 | 17.5 | 10.3 | 34687.5 | 2567.8 | 89.2 | 2845.0 | 332.4 |
| Total | 218701.9 | 419.2 | 602.8 | 15841.8 | 459.3 | 107.5 | 37.3 | 13.9 | 13475.3 | 1638.0 | 66.2 | 1791.6 | 185.8 |
| Mayurbhanj | | | | | | | | | | | | | |
| 1971-80 | 46371.7 | 286.0 | 267.8 | 4702.5 | 374.3 | 40.0 | 9.4 | 2.3 | 1555.3 | 1166.5 | 4.4 | 1415.3 | 44.6 |
| 1981-90 | 78611.8 | 418.2 | 306.1 | 10325.3 | 340.7 | 69.7 | 17.8 | 3.2 | 4396.8 | 894.2 | 8.6 | 1493.1 | 107.4 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991-2000 | 173797.5 | 651.3 | 362.8 | 14054.7 | 304.4 | 38.6 | 9.0 | 1.8 | 10609.3 | 1077.6 | 11.8 | 1390.7 | 141.7 |
| 2001-04 | 231297.8 | 963.7 | 410.2 | 14831.4 | 334.0 | 10.6 | 3.2 | 1.0 | 14358.2 | 1333.7 | 15.9 | 1518.4 | 145.1 |
| Total | 118408.6 | 525.0 | 326.2 | 10428.1 | 339.0 | 43.9 | 10.8 | 2.2 | 6783.0 | 1087.2 | 9.4 | 1445.2 | 104.6 |
| Phulbani | | | | | | | | | | | | | |
| 1971-80 | 17086.7 | 137.8 | 115.7 | 7409.7 | 119.3 | 46.0 | 23.1 | 2.7 | 682.3 | 514.4 | 21.7 | 1186.3 | 43.8 |
| 1981-90 | 41914.1 | 201.3 | 136.2 | 16269.8 | 116.8 | 84.0 | 36.8 | 3.0 | 1605.5 | 557.4 | 26.6 | 1387.0 | 71.2 |
| 1991-2000 | 101447.2 | 313.2 | 162.6 | 22272.0 | 168.9 | 42.4 | 21.9 | 1.8 | 3783.7 | 715.0 | 28.8 | 1468.2 | 80.0 |
| 2001-04 | 115616.0 | 470.0 | 184.1 | 24062.9 | 134.0 | 11.8 | 5.4 | 3.2 | 7448.8 | 923.5 | 32.0 | 1472.5 | 80.6 |
| Total | 62358.9 | 253.5 | 144.7 | 16566.6 | 134.9 | 51.0 | 24.1 | 2.6 | 2798.8 | 642.5 | 26.6 | 1365.1 | 67.2 |
| Puri | | | | | | | | | | | | | |
| 1971-80 | 71551.6 | 845.2 | 184.4 | 6294.6 | 425.7 | 184.6 | 24.4 | 7.5 | 6164.9 | 1082.1 | 17.4 | 1174.4 | 330.5 |
| 1981-90 | 135886.4 | 1226.6 | 228.5 | 13821.8 | 400.4 | 201.2 | 43.4 | 10.0 | 17978.6 | 1144.7 | 21.7 | 1279.8 | 410.9 |
| 1991-2000 | 274041.7 | 1723.5 | 275.6 | 16063.5 | 430.9 | 122.8 | 24.6 | 7.0 | 25781.0 | 1099.4 | 48.7 | 1839.9 | 421.8 |
| 2001-04 | 286388.3 | 2241.8 | 311.8 | 24584.0 | 380.7 | 46.6 | 6.3 | 5.5 | 28664.0 | 1695.8 | 107.1 | 1878.9 | 328.8 |
| Total | 178478.2 | 1404.6 | 241.3 | 13849.1 | 413.5 | 152.0 | 27.3 | 7.8 | 18359.0 | 1192.6 | 40.4 | 1495.3 | 379.3 |
| Sambalpur | | | | | | | | | | | | | |
| 1971-80 | 93903.0 | 477.3 | 321.2 | 8616.9 | 588.2 | 51.4 | 39.2 | 8.9 | 15148.1 | 1221.1 | 9.8 | 1171.7 | 219.9 |
| 1981-90 | 187183.2 | 703.9 | 389.0 | 15340.6 | 520.2 | 119.4 | 82.5 | 9.0 | 42669.3 | 1218.8 | 32.0 | 1242.0 | 343.0 |
| 1991-2000 | 361762.1 | 1052.6 | 451.1 | 21127.7 | 512.8 | 84.5 | 49.8 | 5.4 | 60065.6 | 1168.6 | 40.7 | 2014.5 | 372.3 |
| 2001-04 | 486149.9 | 1457.3 | 495.3 | 28686.7 | 552.9 | 20.7 | 29.4 | 3.2 | 79596.5 | 1447.8 | 63.8 | 2660.9 | 365.5 |
| Total | 253120.9 | 846.4 | 402.5 | 16979.6 | 542.2 | 75.9 | 53.2 | 7.1 | 45051.8 | 1237.8 | 32.7 | 1645.3 | 319.4 |
| Sundergarh | | | | | | | | | | | | | |
| 1971-80 | 29453.3 | 192.9 | 140.1 | 3575.7 | 252.0 | 33.7 | 9.8 | 2.2 | 1323.8 | 590.2 | 2.1 | 1127.9 | 25.3 |
| 191-90 | 51259.0 | 295.3 | 173.6 | 7851.0 | 233.6 | 62.3 | 22.7 | 2.9 | 5605.2 | 710.6 | 3.3 | 1245.2 | 64.8 |
| 1991-2000 | 99055.7 | 444.8 | 203.1 | 11072.4 | 242.8 | 39.0 | 10.4 | 1.8 | 6324.9 | 909.5 | 5.7 | 1349.3 | 88.9 |
| 2001-04 | 117489.7 | 621.8 | 227.3 | 13497.3 | 237.8 | 7.6 | 4.4 | 2.1 | 8686.7 | 957.1 | 9.7 | 1194.2 | 101.1 |
| Total | 68146.5 | 355.4 | 180.1 | 8356.5 | 242.1 | 39.6 | 12.9 | 2.3 | 5027.8 | 768.2 | 4.6 | 1234.1 | 65.6 |