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RESEARCH NOTES

Growth Determinants of Orissa and their Implications for Future Development of the State

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I

INTRODUCTION

Orissa presents a paradoxical picture of poverty amidst plenty. Despite being endowed with vast natural resources such as long coastal line, fertile green coastal plains, rivers, forest resources, and mineral resources such as iron ore, bauxite ore, limestone, the state continues to be a backward state. A comparative analysis of inter-state poverty ratio shows that 47.2 per cent of the state's population lives below the poverty line in 2001-02, which is the highest in India (all India average being 26.1 per cent). Even in terms of human development index (HDI), the state lags behind many other states. As per the National Human Development Report (2001), it secures 11th rank among the major fifteen states. To add to the problems of the poorer sections of population, the state is not only frequently marred by natural calamities like flood, drought, and cyclone, but also has experienced distorted growth trends both in industry and agriculture. In our earlier study, it was shown that both agriculture and industry had undergone negative growth rate during the 1990s (Rath and Jena, 2003). While the coastal area suffers from the ravages of flood and cyclone, the western part of the state is subjected to the vagaries of drought conditions, which further widens the regional disparities. Therefore, the matters of concern for the state economy are: how to abate poverty, and how to accelerate its growth process, so that it can rank on par with other major states. In order to accelerate the growth process, the issues that need investigation are: why did agriculture attain negative growth rate during the Ninth Plan period, why was industry growth rate stagnant, and can the emerging tertiary sector reduce pressure of employment in the agriculture sector? However, among all these issues, in this paper we have examined the various facets dealing with the negative growth rate of the agriculture sector.

With a view to suggest some remedial measures for the declining agriculture sector, an attempt is made to identify the drivers of the sector.

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II

SECTOR-WISE ANALYSIS OF THE GROWTH TRENDS OF ORISSA

An analysis of the growth patterns of population and net state domestic product (NSDP) as given in Table 1 during Sixth to Ninth Plan periods reveals that Orissa has experienced positive growth rates in NSDP during these plan periods except for 1990-91 (annual plan period) in which it had recorded a negative growth rate of –17 per cent. Although, the overall growth rates of NSDP in Eighth and Ninth Plans were positive, i.e., 1.4 per cent and 3.94 per cent, they lagged behind the all India average of 6.8 per cent and 6.5 per cent respectively. However, in spite of the positive overall growth rates during the period, an examination of the sectoral growth profiles reveal that both the major sectors, viz., agriculture and industry had declined. Both the sectors have been distressed due to many institutional and economic constraints. Moreover, the trend in the growth rates of per capita NSDP indicates that the state economy had not been performing adequately to keep pace with the other states.

TABLE 1. GROWTH RATES IN POPULATION, NSDP AND PER CAPITA NSDP IN ORISSA IN DIFFERENT PLAN PERIODS (BASE 1993-94)

Plan periods	Population	NSDP	Per capita NSDP
(1)	(2)	(3)	(4)
Sixth Plan (1980-85)	1.72	2.89	1.15
Seventh Plan (1985 – 90	1.85	7.18	5.24
Annual Plan (1990- 91)	1.95	- 17.00	- 18.60
Annual Plan (1991 – 92)	1.91	12.71	10.77
Eight Plan (1992 – 97)	1.61	1.40	- 1.11
Ninth Plan (upto 2001)	0.97	3.94	2.93

Source: *Estimates of NSDP, 2001,* Directorate of Economics and Statistics, Government of Orissa.

A further analysis of the sector-wise contributions to the NSDP (provided in Table 2) indicates that agriculture still plays a dominant role in shaping the state income. While it used to contribute more than one-third of the total income of the state and more than two-third of the employment, in recent years, its share in NSDP has started declining. The share in employment generation has remained more or less the same (See, Table 3). On the other hand, the share of agriculture in NSDP had gone down from 35.84 per cent in 1991-92 to 28.54 per cent in 2000-2001 owing to the negative growth rate of –1.5 per cent during the period. However, the compound annual growth rate (CAGR) of the agriculture sector over the period 1994-2000 had been 0.66 per cent in Orissa, while it was 5.05 per cent in West Bengal, 2.98 per cent in Uttar Pradesh, 2.19 per cent in Punjab, 2.01 per cent in Haryana and 1.80 per cent in Maharashtra (See, Annexure 1). The sectoral growth rates show that even Bihar had registered higher growth rate in agriculture than Orissa during the period 1994-2000. One of the major concerns associated with agriculture in Orissa is the declining trend of food grains production over the years particularly, the food items, namely, rice, cereals, pulses, and oilseeds had declined steadily during the 1990s. For

instance, the production of rice has declined from 66.6 lakh MT to 51.9 lakh MT, cereals from 68.3 to 53.6, pulses from 4.0 to 2.4, and oilseeds from 2.8 lakh MT to 1.6 lakh MT during the same period (See Annexure 2). Similarly, the contribution of the forestry sector had also gone down. But among the primary sector, the mining and fishery sectors had indicated a rising trend in terms of their contribution to the NSDP.

TABLE 2. SECTORAL CONTRIBUTIONS TO NSDP IN ORISSA FOR THE PERIOD, 1991-2001

(per cent)

Sectors	1991– 92	1993-94	1995-96	1997-98	1999-2000	2000-01
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.Primary	45.16	49.59	46.90	47.18	43.55	42.11
1.1 Agriculture	35.84	38.95	35.71	34.70	30.65	28.54
1.2 Forestry	4.38	3.95	3.42	3.35	3.37	3.48
1.3 Mining	3.26	4.42	5.37	6.33	7.13	7.70
1.4 Fishery	1.69	2.27	2.40	2.80	2.40	2.39
2. Secondary	19.22	16.44	17.50	13.52	11.75	10.70
2.1 Manufacturing	10.91	7.37	9.37	5.47	4.06	2.51
2.2 Electricity and gas	1.55	2.31	1.68	1.59	1.66	1.88
2.3 Construction	6.77	6.76	6.45	6.46	6.03	6.31
3. Tertiary	19.87	15.61	17.02	18.25	17.97	19.50
3.1 Trade and Hotel	16.66	10.33	10.84	11.72	11.53	11.97
3.2 Transport	3.21	5.28	6.18	6.53	6.44	7.53
4. Services	15.74	18.36	18.57	20.71	26.73	27.69
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: *Statistical Outline of Orissa, 2001*, Government of Orissa.

TABLE 3. SECTORAL CLASSIFICATION OF WORKERS IN ORISSA (1981-2001)

(in '000)

Category of workers	1981 Census	1991 Census	2001 Census
(1)	(2)	(3)	(4)
Cultivators	4053 (40.4)	4599 (38.7)	4238 (29.69)
Agricultural labourers	2397 (23.9)	2977 (25.1)	5001 (35.04)
Livestock, forest, fisheries, etc.	207 (2.1)	193 (1.6)	N.C.
Mining and quarrying	72 (0.7)	101 (0.8)	N.C.
Manufacturing and processing			
(i) Household industries	285 (2.8)	324 (2.7)	689 (4.83)
(ii) Other industries	313 (3.1)	364 (3.1)	N.C.
Construction	96 (1.0)	90 (0.8)	N.C.
Trade and commerce	355 (3.5)	558 (4.7)	N.C.
Transport, storage and communication	136 (1.4)	181 (1.5)	N.C.
Other services/other workers	721 (7.2)	991 (8.3)	4344* (30.44)
Total main workers	8635 (86.1)	10378 (87.3)	9573 (67.08)
Marginal workers	1387 (13.9)	1505 (12.7)	4700 (32.92)
Total workers	10022 (100)	11883 (100)	14273 (100)
Total non-workers	16348	19777	22434

Source: Economic Survey, Government of Orissa, 2003-04.

Note: Figures in parentheses are percentage to total workers. *:Other workers in 2001 census constitute all workers except cultivators, agricultural labourers, and household industries. N.C. – Not compiled.

In addition to the decline in agriculture, the industrial performance of the state had been far from satisfactory. The industrial sector had also recorded a negative

growth rate of –5.76 per cent during the nineties when other states like Andhra Pradesh, Gujarat, Maharashtra, and Punjab had achieved remarkable growth rates in their industrial production. The CAGR of industrial sector in Orissa during 1994-2000 was only 1.17 per cent, which was one-sixth of Andhra Pradesh and one-ninth of Uttar Pradesh. The growth rates show that even the industrial sector in Bihar had grown more than four times that of Orissa. Almost all the neighbouring states of Orissa had surpassed the latter in their industry growth rate. The manufacturing industry's contribution to the NSDP had fallen from 10.91 per cent in 1991-92 to 2.51 per cent by 2000-01 in the state. There were many reasons for this receding growth in the industrial sector. During the 1980s, major thrust was given to industrial development in the state. The slogan by the then Chief Minister of Orissa to establish 'thousand industries in thousand days with thousand crores' was a symbolic representation of the policy change. But, unfortunately the promises could never turn out to be realities, rather they remained as pipe dreams in industrial planning. Most of the industrial sites created during the period had become sites of sick industries. Even, the existing major industrial units in Orissa are now either closed or falling sick. Many large industrial units like Neelachal Ispat, MESCO etc. are unable to make any headway in their production. This is evidenced by the fact that the value added by the manufacturing sector in Orissa had decreased significantly in the latter half of the decade, which is indicated in Annexure 3. The growth rate in value added by manufacturing sector in the state had been negative since 1996-97 to 1998-99. In contrast, when we compare the industrial growth pattern in Gujarat, Maharashtra and Punjab, it is evident that the private entrepreneurship and capital have played a vital role in their industrial development. These states have a long-standing tradition of business groups. But in Orissa, the entrepreneurship and private investment is not significant.

In addition to the above mentioned bottlenecks in industrial growth, the infrastructural facilities in the state are not conducive for rapid industrialisation. The state is not able to build up the basic infrastructure, which would have otherwise reduced the cost significantly and paved the way for higher private investment. An analysis of the availability of various infrastructure indicators in the state reveals that except power which is surplus sector in terms of demand-supply equation in Orissa, other important economic and social infrastructure sectors are facing supply side constraints. The transport and communications, which are the key infrastructure sectors are incapable of attracting private investors to the state because of bureaucratic hurdles. Industrial development requires adequate railway linkages so that raw materials and other inputs can be transported to the production units and the output can be transported to different markets easily with less cost. But, barring few parts of Orissa, a large part still remained unlinked with railway network. The density of railway route length per thousand sq. km. area in the state is only around 14.90 km in comparison to 19.21 km at the national level in 2001-2002. Similarly, road network also requires rapid upgradation. According to estimates available with

the Planning Commission, about 40 per cent of the villages in Orissa have all-weather connectivity as compared to 60 per cent at the national level. Moreover, the index of per capita electricity consumption across the states and at the national level indicates that Orissa is lagging behind the advanced states in providing electricity to its people. In 1999-2000, the per capita consumption of electricity in the state was 334 kWh, less than the same at the national level of 365 kWh. The percentage of villages electrified in Orissa till March 2001 was 75 per cent in comparison to 87 per cent at the national level. A state-wise infrastructure availability index places Orissa at 11th rank out of 15 major states (Kundu *et al*., 2002). Lack of adequate transport and communication facilities are hindering private and foreign investment in the state. For instance, *POSCO*, the Korean steel maker, which has proposed to set up a steel plant in Orissa, is now reconsidering its proposal. The company's director of corporate strategic planning, overseas steel plant project, Taw-Hyun Jeong said, "Although there are around 13.5 billion tonnes of iron ore reserves in Orissa, the state does not have a proper port and infrastructure facilities. We have proposed to the state government to provide good infrastructure facilities and we will take a final decision on our India plans depending on what the Indian government is willing to provide".[1] If the company pulls out, the state will lose a steel plant of capacity 10 million tonnes. There are also other instances where private companies have pulled out from their ventures due to poor infrastructure facilities. For instance, *TISCO* has pulled out from its Gopalpur steel project in Orissa. On the other hand, the budgetary allocation in the state for key infrastructure sectors is low owing to paucity of funds. This inadequate infrastructure facility obstructs the growth of the potential in these sectors.

Though, industrial development requires a diversified industrial base in order to ensure the required growth stimuli through inter-industry linkages and agglomeration economies, the factory sector in Orissa is concentrated on the large scale natural resource-based industries and have not diversified to related industries (Government of Orissa, 2004). Ancillary industrialisation is of a very insignificant nature, which reflects the passive industrial base of the state economy. It is particularly significant to find that the state's major industries (constituting more than three-fourths of the total) have been accounted for by only four major industry groups, namely, electricity, basic metal and alloys, non-metallic minerals and food products and have not diversified to related industries, such as, engineering goods, chemicals, agro-based and wood-based industries. This low industrial base has acted as one of the bottlenecks for creating inter-industry linkages and thereby the complementary activities required for industrial development in the state.

Notwithstanding these constraints, the service sector had witnessed impressive growth during the nineties in Orissa. The CAGR for services in the state for the period 1994-2000 stood at 7.53 per cent, which was in comparable terms with the growth of services of other major states. The growth of service sector was 7.02 per cent in Andhra Pradesh, 9.03 per cent in West Bengal, 7.80 per cent in Bihar, 9.26 per cent in Madhya Pradesh, 8.83 per cent in Gujarat, 10.21 per cent in Tamil Nadu,

6.45 per cent in Maharashtra, and 8.97 per cent at the national level during the same period. The contribution of service sector to state NSDP in Orissa increased steadily over the years, i.e., from 15 per cent in 1993-94 to 17 per cent in 1996-97 and finally to 19.5 per cent in 2000-01, which is considered as a normal trend in a developing economy.

Sector-Wise Contribution to Employment

The analysis of sector-wise growth rates in the state suggests that both agriculture and industry sectors are ailing; whereas services sector has shown sound growth. In view of this trend, it is imperative to study the potentiality of these sectors in terms of employment generation which is a key feature of development. The employment figures for 1981, 1991 and 2001 census (provided in Table 3) show that the primary sector has been the main source of livelihood for nearly two-third of total workers. While the shares of agriculture in 1981 and 1991 were 64.3 and 63.8 per cent respectively, it has marginally increased to 64.74 per cent as per 2001 census. Out of the total workers of 142.73 lakh in 2001 census, 29.69 per cent were cultivators, 35.04 per cent were agricultural labourers, 4.83 per cent were engaged in household industries and 30.44 per cent were other workers which include all workers except cultivators, agricultural labourers, and workers in household industries. Interestingly, though, the share of agriculture is reducing in total state income, the percentage of population that depends upon this sector for their livelihood remains more or less the same. Thus, in terms of employment generation and livelihood of the population in the state, agriculture is still the major source of activity.

Sector-Wise Contribution to Per Capita Income

With a view to investigate the contribution of each sector to the per capita income of the state we have attempted to calculate the absolute values in rupee terms as well as their relative shares in percentage terms, the data are contained in Table 4. A critical analysis of the table shows that the primary sector accounts for more than one-third of per capita income in the state. Though, its share has declined from 49.59 per cent in 1993-94 to 36.76 per cent in 2002-03, it still remains the major contributor of per capita NSDP. Among other sectors, while the secondary sector has shown a marginal decline, both tertiary and service sectors have increased their shares in NSDP. Their shares have gone up from 15.61 per cent in 1993-94 to 20.47 per cent in 2002-03 for tertiary sector and from 18.35 per cent to 27.31 per cent for the service sector. A segregation of the primary sector further reveals that agriculture is the major sub-sector in terms of both employment generation and contribution to the per capita income. It accounts for over 95 per cent of employment within the primary sector and 74 per cent of primary sector's contribution to NSDP. In view of these significant contribution of agriculture to the economy of Orissa, any decline in

agricultural production raises serious concerns for the state and also for poverty reduction. Therefore, it is utmost important that a proper analysis of agriculture sector should be carried out so that the limitations can be pointed out and proper corrective measures be adopted by the government. With a view to achieving these objectives, we have undertaken an econometric analysis to find out the various factors/drivers which are responsible for providing a boost to agriculture.

TABLE 4. SECTOR-WISE CONTRIBUTION TO PER CAPITA NSDP IN ORISSA

(Rs.)

Sector	1993-94	1995-96	1997-98	1999-2000	2001-02	2002-03
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Primary	2378.84	2370.21	2503.80	2316.62	2445.39	2145.07
	(49.59)	(46.91)	(46.41)	(39.99)	(41.26)	(36.76)
Secondary	788.75	884.25	712.68	1030.71	856.51	901.92
	(16.44)	(17.50)	(13.21)	(17.79)	(14.45)	(15.45)
Tertiary	748.97	860.24	969.18	971.62	1159.17	1194.93
	(15.61)	(17.02)	(17.96)	(16.77)	(19.56)	(20.47)
Services	880.16	938.31	1209.02	1473.71	1465.93	1594.08
	(18.35)	(18.57)	(22.41)	(25.44)	(24.73)	(27.31)
Total per capita NSDP	4796.73	5053.02	5394.68	5792.67	5926.99	5836.00

Note: Figures in parentheses are the percentage contribution of each sector to per capita NSDP.

III

METHODOLOGY AND RESULTS

As discussed above, agriculture has been the backbone of the state economy because it contributes a major share of the NSDP and also provides the maximum employment opportunities. But, the decline in production and productivity of the sector over the last ten years has become a cause of worry. This trend has also aggravated the existing food security problem for the poorer sections of the society. In view of its significant contributions for the state, the ailing agricultural sector needs to be revitalised and rejuvenated. Such a policy in turn requires an investigation of the important contributing factors to agricultural growth that can be managed efficiently to boost up the ailing agricultural sector. In order to identify the independent variables required for the analysis, first of all, we have analysed the past studies of Ray (1998), Gulati and Sharma (1994), Bhalla and Singh (1997), Vaidyanathan (1999), Nayak (2001), Anant (2002), Pal *et al.,* (2002) and Chadha (2003).

These studies have established that the success of green revolution technology in India in the 1960s and 1970s was crucially dependent upon irrigation and electricity consumption in agriculture. Further, with a view to determining the principal factors influencing agriculture in West Bengal, Vyas (1996.) and De (2003) have used econometric models. Vyas has used regression analysis by applying OLS technique with time series data from 1970 to 1990. The independent variables considered in his model are irrigation, rainfall, chemical fertilisers, and yields of crops. He found that

irrigation and chemical fertiliser are the most significant variables, which affect agricultural productivity. De has also applied a similar regression technique, but the independent variables in his model are irrigation, varieties of seeds, synthetic fertiliser, and area under cultivation. The data period in his study spans from 1970-71 to 1995-96. His findings show that irrigation and area under cultivation are the important factors which influence agriculture in West Bengal.

Adhering to these quantitative approaches, we have undertaken a multiple regression analysis using OLS technique to determine the important factors that influence agriculture in the state. The data for this exercise span from 1980-81 to 2000-01. For the purpose of estimation, we have used the neo-classical production function which is indicated as:

$$Y_t = f(X_{it})$$

where Y_t refers to the agricultural output, 't' the time period, and X_{it}s are the independent variables influencing agricultural output. Assuming a linear relationship and taking into consideration six important variables, we have developed the following model:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \beta_5 X_{5t} + \beta_6 X_{6t} + u_t$$

where Y_t = Agricultural production of the state measured in '000 MT,
X_{1t} = Annual expenditure on irrigation measured in crores of rupees,
X_{2t} = Net area sown measured in'000 hectares,
X_{3t} = Net irrigated area measured in '000 hectares,
X_{4t} = Actual rainfall measured in c.m,
X_{5t} = Consumption of electricity in agriculture measured in million units,
X_{6t} = Chemical fertiliser in '000 tonnes, and
β_0 represents the intercept, and β_1, β_2, β_3, β_4, β_5, and β_6 are the respective partial regression coefficients and u_t is the error term.

Since all the six explanatory variables in the specification may not be relevant for Orissa, a step-wise regression procedure is undertaken to determine the important variables which automatically drops the insignificant ones.

In a step-wise regression model, the explanatory variables are usually added in each step of the estimation. If the adjusted R^2 value increases with the inclusion of a new variable then the latter is considered to be an important variable in the model. On the other hand, if the adjusted R^2 value either does not change or decrease then the concerned variable is considered irrelevant for the model. With a view to identify the important variables, the regression equation is estimated by taking the variables in all possible combinations with the help of SAS software package. In this process 50 regression equations are estimated and out of these equations, 9 are finally retained by taking into consideration the R^2, adjusted R^2, and the t-values of the coefficients.

The rest 41 equations are dropped because of low adjusted R^2 values and insignificant t-values. The relevant regression results are given below:

$$Y = 2440.94 + 3.98X_1(1.26) + 28.76X_4(3.39), R^2 = 0.42, \overline{R}^2 = 0.36 \quad \ldots.(1)$$

$$Y = -25051.51 + 1.38X_3(3.48) + 4.69X_2(2.99), R^2 = 0.47, \overline{R}^2 = 0.41 \quad \ldots.(2)$$

$$Y = 1635.66 + 0.77X_3(2.00) + 25.80X_4(3.13), R^2 = 0.48, \overline{R}^2 = 0.43 \quad \ldots.(3)$$

$$Y = 2792.45 + 25.89X_4(2.94) + 10.54X_5(1.40), R^2 = 0.43, \overline{R}^2 = 0.37 \quad \ldots.(4)$$

$$Y = -2544.62 + 9.33X_1(2.67) + 4.64X_2(2.53) + 19.82X_4(2.39), \quad R^2 = 0.57, \overline{R}^2 = 0.50 \quad \ldots.(5)$$

$$Y = 113.19 - 13.66X_1(-1.64) + 2.44X_3(2.26) + 20.57X_4(2.42), \quad R^2 = 0.55, \overline{R}^2 = 0.47 \quad \ldots.(6)$$

$$Y = -18341.65 + 3.28X_2(2.12) + 1.07X_3(2.80) + 18.82X_4(2.28), \quad R^2 = 0.59, \overline{R}^2 = 0.52 \quad \ldots.(7)$$

$$Y = -19461.85 + 3.75X_2(2.17) + 16.54X_4(1.81) + 19.18X_5(2.41), \quad R^2 = 0.57, \overline{R}^2 = 0.47 \quad \ldots.(8)$$

$$Y = -24882.9 + 7.75X_1(1.0) + 4.56X_2(2.39) + 18.88X_4(2.0) + 3.95X_5(0.23) R^2 = 0.57, \overline{R}^2 = 0.47 \quad \ldots.(9)$$

$$Y = -13455.38 + 2.17X_2(1.22) + 3.51X_3(3.44) + 17.40X_4(1.57) - 8.39X_5(-0.45) - 11.46X_6(-1.46) \; R^2 = 0.64, \; \overline{R}^2 = 0.49 \quad \ldots.(10)$$

Note that the figures in parentheses are the t-values.

A perusal of the regression results suggests that rainfall, expenditure on irrigation, net irrigated area, and net area sown are the significant factors that influence agricultural production of the state. But in all the equations except (2), rainfall (X_4) has appeared as the most important explanatory variable whose coefficients and R^2 values are significant. For example, in equation (7) where the R^2 is the highest, the coefficient of rainfall is 18.82, implies that 1 per cent increase in rainfall level would tend to raise the agricultural production by 18.82 per cent. Similarly, in other equations also rainfall has appeared with large coefficients. The high coefficient values of rainfall establish that agriculture in Orissa is still a gamble of the monsoon. This is also an indication that agriculture in Orissa has largely been traditional. The other significant factors in our results are net area sown and irrigated area [see equations (5), (6), and (7)]. The striking feature is that these coefficients are greater than one suggesting that a 1 per cent increase in these variables would generate proportionally greater effect on agricultural productivity. It is important to note that both irrigated area (X_3) and expenditure on irrigation (X_1) are taken to

represent the contribution of irrigation to agriculture[2]. The results point out that when both are taken together in an equation, the coefficient of X_1 turned out to be negative [see (6)] which suggest that there is multicollinearity in the model. However, when both are taken separately, the coefficients attain positive values and also become significant [see (5) and (7)]. Moreover, the regression results show that two out of the six explanatory variables, such as, chemical fertiliser and electricity consumption in agriculture, which have been proved elsewhere as important variables for agriculture production, are found to be insignificant in case of Orissa [See (10)]. The t-statistics of the coefficients of both X_1 and X_2 are –0.45 and –1.46 respectively. An overall analysis of the regression results have established that rainfall, irrigation expenditures, and net area sown are the important contributors of agriculture in Orissa which need to be nurtured properly for higher agricultural production. In fact, net irrigated area that can be managed by the state through higher expenditure on irrigation need to be enhanced for higher agricultural productivity because the state has no control over the natural factor of rainfall.

However, with a view to examine the relative importance of these variables, we have further extended our estimation by undertaking simulation analysis in which the data sets are manipulated with the help of alternative assumptions. Among the three factors that contribute positively to the agricultural productivity, irrigation expenditure comes directly under the control of the state government that has decisive influence on both irrigated area and net area sown. By assuming that the government increases budgetary allocation towards irrigation by 10 per cent every year, net irrigated area is assumed to increase by 5 per cent and the net area sown by 2 per cent (a conservative estimation only). It is also assumed that the consumption of electricity in agriculture would increase by 10 per cent. With these sets of assumptions, the alternative model is specified as follows:

$$Y_t = \lambda_0 + \lambda_1 X_{1t}^{*} + \lambda_2 X_{2t}^{*} + \lambda_3 X_{3t}^{*} + \lambda_4 X_{4t} + \lambda_5 X_{5t}^{*} + \varepsilon_t \qquad \ldots.(11)$$

where X_{1t}^{*} = simulated expenditure on irrigation,
X_{2t}^{*} = simulated net area sown,
X_{3t}^{*} = simulated net irrigated area,
X_{5t}^{*} = simulated electricity consumption,
Y_t and X_{4t} are as specified earlier, and

λ_0 is the intercept, λ_1, λ_2, λ_3, λ_4, and λ_5 are the partial regression coefficients and ε_t is the error term. With the help of the alternative data set for all the sample years, the coefficient values have been reestimated by step-wise regression, which are given below.

$$Y = 2476.02 + 3.94X_1^{*}(1.28) + 28.48X_4(3.37), R^2 = 0.42, \overline{R}^2 = 0.36 \qquad \ldots.(12)$$

$$Y = -25067 + 4.59X_2^{*}(2.99) + 1.31X_3^{*}(3.48), R^2 = 0.46, \overline{R}^2 = 0.41 \qquad \ldots.(13)$$

$$Y = 1657.52 + 0.74X_3^{*}(2.02) + 25.53X_4(3.12), R^2 = 0.48, \overline{R}^2 = 0.43 \quad \ldots.(14)$$

$$Y = 2831.48 + 25.56X_4(2.92) + 9.70X_5^{*}(1.41), R^2 = 0.43, \overline{R}^2 = 0.36 \quad \ldots.(15)$$

$$Y = -22698 - 2.64X_1^{*}(-0.18) + 4.17X_2^{*}(1.45) + 1.59X_3^{*}(0.99)$$
$$R^2 = 0.47, \overline{R}^2 = 0.38 \quad \ldots.(16)$$

$$Y = -19424 + 3.67X_2^{*}(2.17) + 16.30X_4(1.79) + 17.54X_5^{*}(2.42)$$
$$R^2 = 0.54, \overline{R}^2 = 0.47 \quad \ldots.(17)$$

$$Y = -18362 + 3.22X_2^{*}(2.12) + 1.03X_3^{*}(2.83) + 18.60X_4(2.27)$$
$$R^2 = 0.58, \overline{R}^2 = 0.52 \quad \ldots.(18)$$

$$Y = -25598 + 9.21X_1^{*}(2.69) + 4.57X_2^{*}(2.54) + 19.63X_4(2.39),$$
$$R^2 = 0.57, \overline{R}^2 = 0.50 \quad \ldots.(19)$$

$$Y = -25067 + 7.80X_1^{*}(1.03) + 4.50X_2^{*}(2.40) + 18.76X_4(2.00)$$
$$+ 3.29X_5^{*}(0.21), R^2 = 0.57, \overline{R}^2 = 0.47 \quad \ldots.(20)$$

An examination of the results shows that rainfall is still playing a dominant role in determining the agricultural output in the state. On the other hand, rainfall pattern being dependent on the monsoon varies from region to region in the state. The temporal and spatial distribution is quite erratic. An examination of the rainfall pattern in Orissa from 1970-71 to 2002-03 (provided in Figure 1) shows that it is highly erratic and wanders away from the trend line. The trend establishes that out of thirty years, the state has experienced highly erratic rainfall for nearly twenty years; which has resulted in either drought or flood. This erratic behaviour of monsoons have caused fluctuations in agricultural production and thus, significantly affected the agricultural productivity in the state. To overcome the problems of this erratic trend, there is a need to harvest the rainwater, which is capable of paying a dividend to the farmers. Rainwater harvesting being one of the key instruments of watershed management should be carried out extensively. Rainwater collected and used near the site may either replace or supplement other source of water for household use or for irrigation. Cost of rainwater harvesting system is much lower than creating a drilled well and pumping system or construction of major dams and design of irrigation system. These projects should involve the local communities as people's participation is an essential element for the success of these projects. There are several benefits in community based rainwater harvesting projects that would provide immediate livelihood to the target communities and thereby minimise the migration of people to other parts of the country in search of livelihood. Secondly, management of these projects involves lower level people's institutions, such as, Panchayats in implementation and monitoring which will enhance the efficiency of the project. Further, community involvement in the project planning would help

identify and focus on the priority areas for targeted people. Importantly, community participation will imbibe the sense of ownership among the people. There are evidences of successful rainwater harvesting structures which have raised productivity of agriculture, for example, *Johads* constructed with the help of *Tarun Bharat Sangh* (TBS) in the Alwar district of Rajasthan have transformed several villages in that district which were severely drought hit areas into lush and green (Agarwal and Narain, 2003). There are also instances from Orissa where rainwater harvesting structures have yielded benefits to productivity, e.g., although Ganjam district is endowed with the lowest rainfall in the state, its agricultural productivity is relatively high owing to the availability of a number of rainwater harvesting structures like tanks and check dams, those were constructed before Independence under the able guidance of the then Madras Residency engineers.

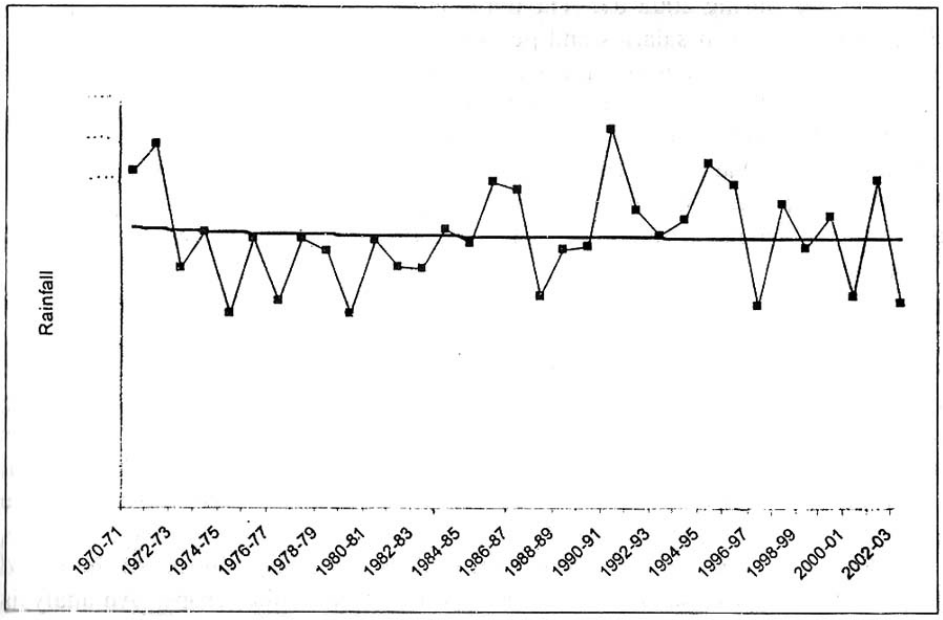

Figure 1. Rainfall Pattern in Orissa

The other significant variables are net area sown, and expenditure on irrigation, and net irrigated area, which are relatively low in the state. The coefficients of net area sown are 3.22 in (17) and 4.57 in (18). Similarly, the coefficient of expenditure on irrigation is 9.12 in (18) and the coefficient of net irrigated area is 1.03 in (17). By comparing these results with the unsimulated results, it is established that our model is consistent in estimating the coefficients of variables that affect agriculture significantly in the state. The high coefficient value of irrigation expenditure call for more investment in irrigation projects of different forms to provide assured water supply for agriculture.

An inter-state comparison of net irrigated area (provided in Annexure 4) shows that the percentage of area irrigated to total net area shown in Orissa is 34.40 per cent, which is below the national level of 40.53 per cent. Some of the states which are agriculturally more advanced have substantial irrigated facility, such as, Punjab (94.48 per cent), Haryana (81.31 per cent), and Uttar Pradesh (71.49 per cent). Therefore, there is a need to augment the irrigation facilities by carefully designing irrigation projects and to revitalise the old ones.

However, the government efforts to supply adequate irrigation infrastructure to the farmers are constrained by financial crunch. The state has been experiencing serious fiscal deficit for several years and is currently facing a serious fiscal crisis. The fiscal deficit of the State has shown a rising trend since 1995-96. It has increased from 7.8 per cent of the gross state domestic product (GSDP) in 1995-96 to 24.6 per cent of the GSDP during 2002-03. The burgeoning non-plan expenditure arising out of substantial increase in salaries and pensions and the widening gap between non-plan revenue expenditure and receipts have necessitated higher borrowing and higher debt servicing liabilities. The total outstanding debt of the state constitutes 60 per cent of the NSDP and more particularly, the interest paid annually is more than 20 per cent of NSDP. Due to this financial crisis, the state government finds it difficult to provide adequate investment to build the required infrastructure for agriculture. Owing to the financial crunch, the share of irrigation in the state's budgetary allocation was only a paltry 10 per cent in 2001-02.

In the face of these financial constraints, the agricultural policy in the state needs to consider various alternative strategies in order to build agriculture as a profitable and commercially viable venture. One such alternative strategy is to examine the viability of crop diversification system in the state by adopting mixed/inter-cropping pattern. The varied agro-climatic conditions of the state provide scope for horticulture, cultivation of vegetables, plantation crops, spices, flowers and medicinal herbs. Since, there is scarcity of data regarding the crop diversification pattern in the state, we have plotted the decadal production of crops from 1950-51 to 2002-03 (See, Figure 2) to find out the trend of production of different crops in terms of the broad category of rice, other cereals, pulses, oilseeds, fibers, and other crops. An analysis of the data plotted against the crop category shows that rice has traditionally been cultivated in the state dominating other crops. However, there was a decrease in the rice production in 1970-71 to 1990-91 and increase in the production of pulses, oilseeds, and other crops during the same period which can be considered as an indication of crop diversification. But, again the production of rice and other cereals have picked up from 1990-91 to 2002-03 and there was a decrease in the production of oilseeds, pulses, and other crops. Further, an examination of the percentage of area under each crop to gross cropped area suggests that crop diversification has taken place to certain extent in the state. For example, cultivation of the crops that need less water such as *arhar*, groundnut and ragi has increased in terms of their area holdings. Though, the agricultural department has been trying to experiment with

crop diversification, so far the state has achieved limited success. They have developed various schemes such as integrated crop development programme in the rice based cropping system (ICDP-Rice), sustainable agriculture in sugarcane-based cropping system (SUBACS), and special jute development programme (SJDP). Apart from these, some other schemes like agricultural mechanisation, balance and integrated use of fertiliser, *ragi* development and crop diversification are also planned to be implemented in the state. The proposed work plan for the year 2004-05 is based on different interventions, viz., technology transfer, seed intervention, farm mechanisation and infrastructure development. To boost productivity in different crops, thrust will be given to interventions like farmers' field school, exposure visit of the farmers, increase in seed replacement ratio (SRR) through distribution of certified seeds and farm mechanisation ought to be encouraged. The objectives of such programmes are to demonstrate feasibility and profitability of growing situation-specific non-paddy crops by using critical inputs, to train the participating farmers from sowing to harvesting on skill upgradation, and to evaluate the effect of demonstration.

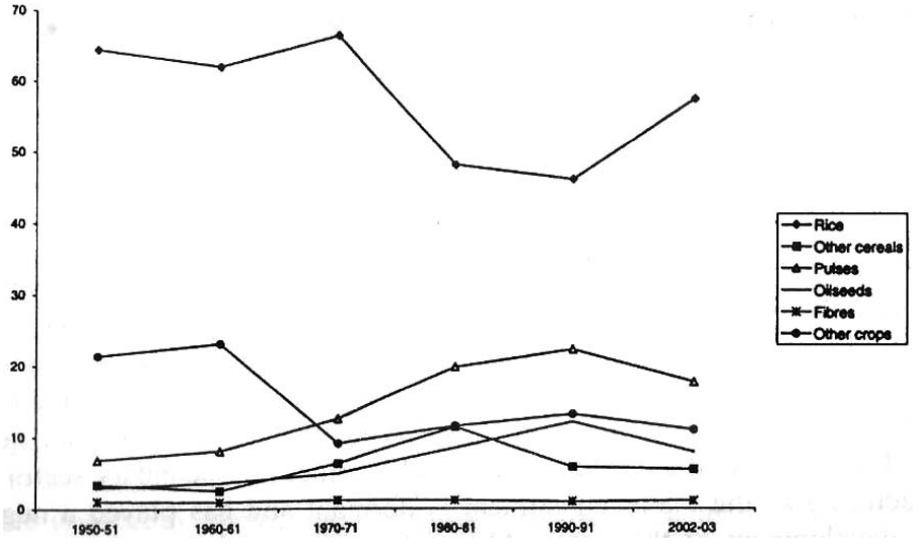

Figure 2. Cropping Scenario in Orissa

However, the major problem with these crop diversification programmes is that any diversification from paddy to non-paddy crop even requires regular doses of water. Without assured water supply, these efforts would not be successful. Moreover, the farmers in the state need staple food for which they are required to cultivate paddy. Besides as crop diversification has not proved to be profitable and does not give the farmers desired results, the farmers are not willing to shift to other

crops. It is noted that so long as mixed/inter cropping pattern has not been proved to be profitable; the farmers would not be willing to shift from their traditional crop cultivation. Furthermore, as the farmers have been cultivating paddy for long time, they are comfortable with its cultivation process. Any shift from paddy to non-paddy crop will require additional amount of skill and training. Government has so far failed to provide adequate training due to lack of manpower and financial resources.

The regression results further establish that two of the explanatory variables, i.e., chemical fertiliser and electricity consumption in agriculture are insignificant in the model. The findings suggest that there is hardly any correlation between agricultural production and these inputs in the state during the period 1980-2002. This finding holds importance for agricultural productivity of the state, because agricultural productivity crucially depends upon modernisation in this sector and use of sophisticated techniques in different activities of cultivation, such as, sowing of seeds, irrigating the land, and cutting and harvesting of crops. These sophisticated techniques require electricity as an important component in its use. Since, there is very low level of electricity consumption in agriculture in the state, the state of cultivation has remained mainly traditional. The use of chemical fertiliser is considered to be a catalyst in the augmentation of agricultural production. But, our results show that it bears no correlation with agricultural production in the state. This indicates that adequate amount of fertiliser is not used in the cultivation process which has resulted in low productivity in agriculture in the state.

IV

CONCLUDING REMARKS

Even though, Orissa is endowed with huge natural resources, the economic growth scenario in the state provides a grim picture. The sector-wise growth patterns in the state in the post-liberalisation period has pointed out that agriculture is still the prime sector of the economy in terms of its contribution to per capita income and employment generation. But it has been suffering from stagnation and negative growth rate for the last half a decade. On the other hand, the secondary sector which has manufacturing as the major constituent is dormant and has played a negligible role in the development of the state. Although, tertiary and services sectors have grown considerably in the last decade, they have failed to ease the pressure on agriculture in terms of providing livelihood to 36 million people in the state.

In view of the contribution of agriculture to poverty reduction in the state, an attempt has been made to identify the key factors that can enhance agricultural productivity. For this purpose, a step-wise multiple regression analysis is undertaken considering annual agricultural production as the dependent variable and a host of inputs to agriculture as the independent variables. With the help of annual data spanning 1980 to 2002, we have found that rainfall, irrigation expenditure, net irrigated area, and net area sown are the principal determinants of agricultural growth

in Orissa. Analysing the regression results, we suggest the following measures that need to be taken up by the government in order to raise the productivity in the agriculture sector of the state. First, since rainfall is a natural factor and cannot be managed, there is a need to promote various schemes to harvest the rainwater of the state in the form of irrigation projects. By paying due attention to the importance of rain water conservation, the state government should take appropriate measures in the form of higher investment to tap rain water and preserve it to improve the net irrigated area in the state. Moreover, though our study has re-established that irrigation is an important contributor to the productivity of agriculture, a critical analysis suggests that adequate attention is not given to develop a well-planned irrigation system in the state. This indifferent attitude on part of the government can be attributed to the serious financial crisis that the state is suffering from. Hence, alternative preventive measures should be undertaken in collaboration with the people so as to ease the burden on the state exchequer. Secondly, since agricultural techniques are mainly traditional in the state, it has affected the productivity negatively in this sector by rendering it to depend upon weather heavily. So, there is an urgent need to modernise this sector by adopting a multi-pronged strategy based on stakeholders' approach. The important ingredients of such a strategy are involvement of all stakeholders including NGOs for use of recommended doses of fertilisers, use of machines and modern techniques in cultivation, and creating adequate infrastructure facilities for agriculture.

Finally, taking into consideration the problems associated with crop diversification systems, it is important to ensure that favourable conditions be created in the state by providing farmers with high-yielding varieties of seeds, proper training, know-how, and adequate financial support to shift from paddy to non-paddy crops. Even demonstration projects should be set up in the backward areas by the specialised agency of the government in collaboration with the agricultural university and *Krishi Vigyan Kendras.* It is strongly advocated that unless, these facilities are provided to the farmers at government initiatives, crop diversification would not be successful in the state. Hence, attempts should be made to create awareness among people to use high-yielding seeds, appropriate doses of fertiliser, cultivating various profitable non-paddy crops, and using modern tools and techniques of production. With a view to carrying forward such awareness, regular training programmes with a proper campaign mechanism should be undertaken. Above all, the success of such initiatives primarily depends on proper planning of projects, a strong political will and, the participation of the people in the management of our development projects.

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NOTES

1. "Posco may pull plug on Orissa Project", http://ushome.rediff.com/money/2004) Oct/19 posco.htm, October 19, 2004.

2. Taking into consideration that the expenditure on irrigation figures might have been inflated over the years, we have taken a 7 per cent rate of discount to deflate the data to 1980-81 level, the beginning of our data series.

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ANNEXURE 1

SECTORAL GROWTH RATES OF FEW MAJOR STATES, I.E., CAGR FOR THE PERIOD, 1994-2000

(per cent)

States	Agriculture	Industry	Services
(1)	(2)	(3)	(4)
Andhra Pradesh	1.53	6.95	7.02
Bihar	0.00	5.94	7.80
Gujarat	1.18	7.21	8.83
Haryana	2.01	6.38	9.26
Madhya Pradesh	1.73	5.03	7.03
Maharashtra	1.80	6.03	6.45
Orissa	0.66	1.17	7.53
Punjab	2.19	6.83	6.89
Tamil Nadu	1.23	6.15	10.21
Uttar Pradesh	2.98	9.16	6.14
West Bengal	5.05	7.39	9.03
All India	3.03	6.24	8.97

Source: Monthly CMIE publication, Uttar Pradesh.

ANNEXURE 2

TREND OF AGRICULTURAL PRODUCTION IN ORISSA

(*lakh MT*)

Year/Crops (1)	Rice (2)	Cereals (3)	Pulses (4)	Total FG (5)	Oil seeds (6)
1991 – 92	66.6	68.3	4.0	72.3	2.8
1992 – 93	53.9	55.6	4.0	59.6	2.5
1993 – 94	66.2	68.4	3.8	72.2	2.7
1994 – 95	63.5	64.9	4.1	69.0	2.4
1995 – 96	62.2	63.7	4.1	67.8	2.4
1996 – 97	44.4	46.1	2.0	48.1	1.7
1997 – 98	48.4	49.2	2.0	51.2	1.7
1998 – 99	50.2	51.5	2.4	53.9	1.6
1999 – 2000	51.9	53.6	2.4	56.0	1.6

Source: *Orissa Economic Survey*, Directorate of Economics and Statistics, Bhubaneswar.

ANNEXURE 3

VALUE ADDED BY MANUFACTURING SECTOR

(Rs. lakhs)

Year (1)	Value added (2)	Growth rate (3)
1990 – 91	89793	-
1991 – 92	125084	39.3
1992 – 93	148207	18.48
1993 – 94	167734	13.17
1994 – 95	209983	25.18
1995 – 96	259089	23.38
1996 – 97	222400	-14.16
1997 – 98	217100	-2.38
1998 – 99	102500	-52.78

Source: *Orissa Economic Survey*, Directorate of Economics and Statistics, Bhubaneswar.

ANNEXURE 4

GROSS CROPPED AREA, NET AREA SOWN, AND NET AREA IRRIGATED OF FEW MAJOR STATES FOR THE PERIOD, 1999-2000

States (1)	Gross cropped area ('000 hectares) (2)	Net area sown ('000 hectares) (3)	Net irrigated area (percentage of net area sown) (4)
Andhra Pradesh	13023	10610	41.32
Bihar	9979	2701	48.30
Gujarat	10152	9667	31.88
Haryana	4385	3552	81.31
Madhya Pradesh	20419	8984	37.56
Maharashtra	22351	17691	16.80
Orissa	8524	6075	34.40
Punjab	8240	4238	94.48
Tamil Nadu	6519	5464	54.39
Uttar Pradesh	24103	16801	71.49
West Bengal	9545	5472	34.93
All India	181740	141231	40.53

Source: Compiled from different sources.