Comparative Performance of Agricultural Sector in Andhra Pradesh and Orissa

A Thesis Submitted for the Degree of Doctor of Philosophy in Economics

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CERTIFICATE

This is to certify that the dissertation entitled "Comparative Performance of Agricultural Sector in Andhra Pradesh and Orissa" submitted by Itishree Pattnaik in partial fulfillment of requirements for the award of the degree of Doctor of Philosophy in Economics is original and the work has been carried out under my supervision. The dissertation or a part thereof has not been submitted for any other degree to this university or elsewhere.

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DECLARATION

I hereby declare that the work presented in this thesis entitled, "Comparative Performance of Agricultural Sector in Andhra Pradesh and Orissa" has been carried out by me under the supervision of Dr. R. Vijay in the Department of Economics, University of Hyderabad. I declare to the best of my knowledge that no part of the thesis was earlier submitted for the award of research degree of any other university or institute.

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Synopsis of the Doctoral Research

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A Synopsis Submitted to the University of Hyderabad Prior to the Submission of Doctoral Thesis

One of the puzzles that exist in Indian agriculture is the differential performance of states. There are three interrelated sets of literature that explains the differential performance of states. One set of literature identified that the growth rate of crop output and income is different for different states. Some states identified as high growth states whereas some other states identified as low growth states in terms of agricultural income and output. The second set of literature analysed whether regional differences are increasing or decreasing. The studies suggested that the degree of regional disparity in agricultural development has been increasing in terms of income from agriculture. The third set of literature analysed whether there is convergence in rate of growth of income in the different states. The studies showed that there was no evidence of convergence among the states with respect to the per capita net state domestic product. This implies that the Indian states grow differently with respect to the income and output.

The factors that are identified in literature to explain the differential growth performance among the states can be classified into four categories. The first set of factors that lead to the differential growth performance is the existence of different natural conditions i.e. the amount of rainfall is not homogenous for the states. The second set of factors that is identified in the past studies is the difference in the state policy. Agriculture is a state subject and the performance of the agriculture mainly depends on the individual state's policy. State policies can be in the form of land reform or public investment into irrigation or the introduction of new technology by green revolution. The benefits from the land reform were different for different states. Land reform was successful in some part of the country but in the case of Orissa, Bihar and Rajasthan it witnessed marginal influence. Public investment in the form of irrigation was also different from one state to other. Some state took initiative to invest on irrigation like canal irrigation in Punjab, Haryana and Tamil Nadu. According to some other literatures the regional difference in the agricultural performances increased after

the state led plan for the introduction of the new technologies into agriculture. The flow of green revolution was different for different states, and therefore the gain out of it was also different. The third set of literature mentioned that the difference in the private initiative in terms of crop diversification and well irrigation can also lead to the differential performance among the states. Crop diversification may lead to increase in farm profit, as well as it helps to avoid risk and uncertainty due to climatic variation. The states like West Bengal, Assam, Maharashtra, Karnataka, Gujarat, Rajasthan and Andhra Pradesh witnessed increase in crop diversification and thus increase in the agricultural output in between the period 1980-1998. The fourth set of literatures established the fact that the initial arrangement of the inputs, affects the present day performances. The historical arrangements like land distribution pattern and public investment at the colonial period led to the differences in the distribution of wealth among the states.

While analyzing the performance of the economy, the received literatures assume that the structures of all state economy are similar. But the structure of the economy can be different from one state to other. One can broadly identify two economic structures. One is a market-oriented structure and the other one is the non-market or traditional or pre-capitalist structure. In a traditional economy the exchanges are personal with an absence of markets for the inputs and production is organized for self consumption. The farming community hardly practices any new methods either by trail and error or from other sources. Thus the risk and uncertainty was low and it arises only when the transformation gets under way. On the other hand in a modern economy, production is a conscious action of agents and is called science based. But in a market oriented economy the exchanges are mediated by the anonymous market and there exists markets for input as well as output**.** A market economy can generate higher levels of growth when compared to the traditional economy. In a modern economy the land and the natural factors of production are substituted by the technology. The performance of the economy to a large extent depends on levels of specialisation and the technology used in the production process. In contrast in a traditional economy, which is repetitive in production systems, the performance gets defined in terms of the ‘natural’ conditions and the extent of land under cultivation.

Indian agriculture at the time of independence witnessed non-market and pre-capitalistic structure. The process of agrarian transformation was not complete. The market for primary inputs like land and labour are not completely formed. Thus the Indian states witnessed "Dual Economy", which implies the existence of both traditional and modern or science based agriculture. But the importance of the market economy is not homogenous for all the states. In an economy when the market based economic structure dominates, the agricultural performance in term of output and income will be better compared to other states with less dominance of the market economy. Thus in a dominantly market oriented structure, the performance of the agricultural sector dominate by the modern inputs and the crop diversification towards the market oriented crops. In such an economy the performance of agricultural sector in term of structural break, growth pattern and short run fluctuations depends on the modern inputs. But with a relatively less dominance of the market structure, the economy's performance depends on the natural and the land related factors. Thus in such economies the performance of agricultural sector in term of structural break, growth pattern and short run fluctuations depends on the land and land related factors.

The present study attempts to bring the structure of the economy as an important feature for analysing of the performance of agricultural sector in term of growth and cyclical fluctuations. The study tries to understand the performance of agriculture and thus analysed the cause for the differential performance among states. Thus the study analysed the effect to the cause. In other words an attempt has been made here to understand whether the modern inputs dominate the performance of the agricultural sector overtime (1960-61 to 2005-06). If the 'modern inputs' and crop diversification significantly influence the performance of the state economy we presume that market-oriented economy is relatively more important in the state. But if land and nature based factors influence the performance of the economy we presume that traditional economy plays an important role.

The study has four objectives.

i. The first objective of the study is to find the phases in the agricultural performance of two states.

ii The second objective analyses the factors accounting for the breaks and whether it is land based or modern inputs.

iii. The third objective analyses the factors accounting for growth and whether the factors are land based or modern inputs based, for each phase in the two states.

iv. The fourth objective analyses the year to year fluctuations in the agricultural sector and analyses whether the cycles are land based or modern inputs based, for each phase in two states.

For the analysis the study considers two states, namely Orissa and Andhra Pradesh. The present study considers net income from agriculture as the main indicator to examine the agricultural growth rate over the period. The data about Net State Domestic Product (NSDP) in agriculture was collected from the Director of Economic and Statistics of the respective states. The period of analysis is from 1960-61 to 2005-06.

The thesis is organized into six chapters. The first chapter states the problem dealt by the present work. The second chapter introduces the difference in structure between the two states. The third chapter makes an attempt to examine the structural break points in the agricultural income in two states and to understand the factors accounting for break points. The factors influencing the agricultural income growth rate in different phases were examined in the fourth chapter. In the fifth chapter an attempt has been made to analyse the short run fluctuation in agricultural income. The co-movements of the agricultural income and the variables are studied in this chapter. The last chapter presents the conclusion of the study.

The structure of two economies is studied from both supply and demand side. The structure can introduce constraints to the agents to expand the production by constraining the demand that exists or constraining the supply of goods by the agent. A supply side constraint arises when the agents want to expand their production but does not expand it as they feel that they will not be able to appropriate the returns from their 'effort' of expanded production. Thus the agent has an incentive problem to invest.

There are three set of supply side constraints identified in the study. The land settlement introduced before the independence period has the influence on the performance of the sector. When land market as a re-allocating system is under-formed then the allocation of land to individual becomes constraint to the performance. If more land is allocated to the non-cultivator, the investment in the land is low. The private property right on land is necessary for the better investment on land. In India, the Roytwari system is the closest approximation of individual private property rights. In the Zamindary system there exists the intermediary between the farmer and the government that affect the investment capacity of the agent. Different Indian states have different combination of the land settlement, thus the result from the land reform is different. In Orissa the higher proportion of land was under the Zaminadari and the under Princely states at the time of independence. But the land settlement introduced by the British for Andhra Pradesh was more conducive for the appropriation of increases in the output when compared to Orissa due to the higher proportion of land under ryotwari settlements. The implementation of land reforms measures was relatively more successful in Andhra Pradesh when compared to Orissa. The second type of supply side constrained faced by the agent due to the structure is the share of the tribal population in the economy. In an economy, where the share of tribes is high the investment in agriculture becomes low. The comparison of two economies shows that in Orissa the share of the tribes was significantly higher than Andhra Pradesh. In Orissa, around one fourth of the population were tribes (according to 2001 census), thus the incentive to invest is low in the economy. The third supply side constraint is the distribution of labor force in two states. A large share of the non-workers imply a larger share of output being distributed for consumption purpose thus low share of output is used for investment purpose. The share of the non-workers in Orissa was higher compared to Andhra Pradesh in the 2001 census.

The demand side constraint is introduced by the structure when the agent does not want to expand the production because of lack of demand in the economy. The study identified two set of demand side constraint faced by the agent. The distribution of land holding pattern is different in two states. The increase in small farmer holding, who produce foodgrains and do not specialize in agricultural production may constraint demand for good produce by the

structure. In Andhra Pradesh the share of the small farmers was higher than Orissa. The allocation of the labour in the different sector of the economy can also lead the constraint in the demand side. With the process of development one would expect the change in composition of labour as well as output. If more share of labour is engaged in the industry sector that leads to migration of labour from agriculture to industry that in turn leads to increase in demand for goods and services. The share of workers engaged in the industry and services sector was much higher in Andhra Pradesh compared to Orissa.

This shows the structure of the two economies is different comparing both the demand side and supply side. Andhra Pradesh economy witnessed higher share of the land with private property rights, low tribal population, higher share of working population and shift of the workers engaged in agricultural sector towards the industry and service sector. Thus the Andhra Pradesh economy witnessed the structure which is comparatively more conducive for the agricultural growth compared to Orissa.

The structure of two economics being different from one another the agricultural performance of the two states was studied by taking income from agriculture as the main indicator. The growth rate of net state domestic product originating from agriculture is estimated by using exponential growth rate. The growth rate of agricultural income was higher in Andhra Pradesh than Orissa. The whole period of analysis is divided into three different phases derived endogenously from the data. In all the three phases the growth rate of agricultural income witnessed an increasing trend for Andhra Pradesh. But the growth rate of agricultural income declined from the first phase to the third phase in Orissa. In comparison, one finds that the growth rate of agricultural income increased in one state, whereas in the other it declined. There exists a difference in the growth profile of agricultural income in two states because the nature of generation of each phase was different.

Agricultural income is a function of area, yield and crop diversification. The break points in net income from agriculture can result due to structural break in the area under cultivation or structural change in yield or due to crop diversification. So the growth of agricultural

income can be disaggregated into a set of physical factors viz. area, yield and crop diversification. To understand the aggregate performance of the economy the study used index number of area, yield and crop diversification. The index numbers of area, yield and production was calculated by taking 1998-99 as the base year.

The first structural break for agricultural income (1975-76) in Andhra Pradesh was generated due to the yield expansion. The calculated index number of yield and income from agriculture witnessed structural break at the same period with an increasing trend. The index of area also witnessed a break point in the same period (1975-76) but its growth rate declined after the break, thus the break in the income series was mainly due to the yield break. The factors accounting for the second break point in agricultural income for Andhra Pradesh was primarily due to the increase in the crop diversification.

In the case of Orissa the factors accounting for break points was different from that of Andhra Pradesh. The first structural break point of agricultural income in Orissa was on 1976-77, and the growth rate of income declined after the period. The index of area and diversification also witnessed a break in the same period. But the index of area witnessed increase in growth rate after the break. After the first break the state witnessed diversification from rice towards inferior cereals. Thus the increase in the area under cultivation shifted from rice towards inferior cereals and the shift towards inferior cereals did not help in increasing the aggregate income. The yield index did not witness any break in the first period. This implies that the effect of green revolution was negligible in the state. The shift from second phase to the third phase in Orissa was mainly due to the decline in the index of both area and yield. Both area and yield index witnessed decline in the trend after 1991. The thirds phase in Orissa witnessed decline in the crop diversification and the increase in the specialization of crop production.

Thus the above analysis shows that in Andhra Pradesh the yield and crop diversification were the prominent factors leading towards the structural break in the aggregate income. But in Orissa area under crops continued to be the important factor for the decline growth rate in the aggregate income.

The factors accounting for break points are different thus by implication the sources for the growth in agricultural income should be different from one another. In this case, the whole period analysis may not provide a clear understanding of the factors affecting agricultural growth rate in each phase. Thus the importance is shifted towards the phase wise analysis of sources of growth rate. With the time period one can expect the importance of the land and land related factors to decline and importance of the modern factors to increase. In order to understand the change in importance of the traditional (like rainfall and area under cultivation) and modern factors (like modern inputs and private investment), a set of variables are taken into consideration. Different models have been used for measuring the change in growth performances in three different phases. The impact of the independent variables for different phases was examined by taking multiple regression analysis by using ordinary least squares (OLS). The present study considers more than one model for each phase because use of single model is not appropriate on econometric ground as it poses serious problem of multi-collinearity problem.

The first phase in Andhra Pradesh witnessed the phase of intensive cultivation with increase in the public provision of irrigation and area under double cropping. There was increase in the importance of the modern inputs in the second phase and diversification towards cash crops in the third phase. Thus Andhra Pradesh agricultural sector witnessed a transformation from traditional based cultivation system towards modern agriculture. Quite contrary to Andhra Pradesh in case of Orissa, the first phase witnessed an increase in the irrigation with the shift of the cropping pattern towards inferior crops like bajra and jowar. The uses of modern inputs like HYV seeds and fertilizer increased in the second phase but the aggregate agricultural income declined. The decline in the aggregate income was revealed due to the decline in the land under cultivation. Thus even if the growth rate of the utilization of modern inputs increased, its realization towards the output was negligible. In the third phase, there was decline in the aggregate income and it was highly influenced by the amount of rainfall. It implies the third phase in Orissa represents a natural or traditional economy where the application of the modern technology was insignificant.

The comparison of two economies shows that while in Andhra Pradesh over the period the dominance of land and natural factor as a source of growth declined and the importance modern inputs and crop diversification plays a central role. But in case of Orissa the importance of land and natural factors continue to play an important role.

The factors accounting for break points in agricultural income are different in each phase and also the sources of growth rate for each phase are different. In this case the nature of the short run fluctuation can be different from one phase to other. Also the sources of fluctuation in income can be different from one set of economic system to another. Different economic system may have different combination of production structure thus generates different types of cyclical behavior pattern in the growth process. The present study calculates the year to year fluctuation in the agricultural income by counting the number of cycles present in the series. One of the important features in the study of cyclical pattern is the recognition of that variables fluctuate together or there exists co-movement between variables. In case of agriculture, production/income has co-movement with rainfall, inputs used etc. The co-movements between the income and the factor inputs are measured by the correlation coefficient between income and the set of inputs used in the analysis.

The study found that the cycles in agricultural income and land or natural factors correlated with each other for Orissa in all the three phases. The cyclical behaviour pattern in the agricultural income for Orissa was due to the cycles exists in the land under cultivation, area under foodgrains and rainfall in all the phases. On the other hand in Andhra Pradesh the factors influenced the cyclical pattern of agricultural income has changed from one phase to another. In the first phase area under irrigation, area under cash crops and the land cultivated witnessed significant influence on the fluctuation in the aggregate income. The cycles exist in the uses of modern inputs explained the cyclical pattern of the income at the second and the third phase. In Andhra Pradesh over the time period the co-movements of the modern inputs with agricultural income increased and the affect of the traditional factors declined.

The above analysis of break points, sources of growth and the short run fluctuation in two states, Andhra Pradesh and Orissa shows that the nature of growth process is different in two states. The structure of two economies was also different from one another.

In 1960's agricultural sector in Orissa witnessed a relative dominance of traditional sector when compared to Andhra Pradesh. Over time, the importance of modern sector increased in both the states. But in the process of evolution of Andhra Pradesh agrarian economy, markets in terms of increasing share of land allocated to market oriented crops, increased private investment and importance of modern inputs is increasing. These trends are not true for Orissa. In addition, the growth process in Orissa continues to be constrained by land related factors while Andhra Pradesh seems to have substituted modern inputs for land. Therefore, one finds that the Orissa economy continues to be land constraint with traditional economy being predominant in the composition of the economy and with lower levels of performance. In contrast, Andhra Pradesh economy has a composition of relatively lower traditional sector when compared to Orissa. .To conclude, the study finds that the initial structure as well as the evolving structure of the two states is different in terms of the growth and fluctuations. Therefore, the state level comparison of the performance of the agriculture sector depends on the structure of the particular state economy. Hence, the present study concludes that to analyse the performance of the economy, the structure of the economy needs to be studied.

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Itishree Pattnaik

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Chapter: I

Introduction

The Problem:

Pre independent India was characterised by a stagnant agrarian economy with large differences between various regions in their performance. The growth rate of crop output was 0.4% between 1891 and 1946[1] (Rao and Despande 1986). The structure of the economy at the time of independence was largely identified as pre-capitalist/non-market based structure. In the post independence period, the leaders of Independent India wanted to initiate development and growth in the agrarian economy and also aimed at implementation of policies to reduce regional disparities. The method, as visualized by the leaders, for initiating development and/or growth was a State-led planned development process. The received literatures identified the stagnancy in Indian agriculture as a result of the low levels of investment and the related lack of incentives for agents to invest in productivity enhancing changes. One of the important constrains for the low level of investment in agriculture is the nature of institutional structure in agriculture. A process by which institutional structure constraints growth via low level of investment are nature of land rights and the existence of series of intermediaries between the state and cultivators. In the early post independence period there was an attempt to bring about a change in the institutional arrangements in agriculture with public policies like Land Reforms, provision of credit via formal institutions, marketing regulation etc. One of the principal movements to change the institutional structure of agriculture was the land reform measure. However, land reform measure was a mixed bag of successful and failed attempts to change the institutional structure of agriculture. Abolition of intermediary was to a large extent a success but other measures in land reform were a failure like ceiling abolition, tenancy regulation etc. The limited success of land reform in terms of abolition of intermediary was seen as one condition for the increase in land under cultivation. Simultaneously the state also increased public investment in agriculture, one of the forms of the public investment being public provision of irrigation. This has led to a massive expansion in land under cultivation. Thus the growth in the period has been identified as an extensive type with a

[1] It has been pointed out by Vaidyanathan (2000) that in the growth rate of crop output in the period before independence was below 1 percent.

growth rate of agricultural income around 2.66 percent in the fifties (Abel 1970). In the same period the growth rate of foodgrain production was 2.5% and growth rate of total crop production was 3% (Rao and Despande 1986). But by the mid 1960's the agricultural sector faced a major food crisis leading to change in policy towards a technical solution to the problems of agricultural sector without changing the institutional structure. This is generally identified as the "green revolution' policy. The green revolution policy depends on public provision of subsidized inputs necessary for production. In between the period 1962-65 to 1970-73 the new seed fertilizer technology led to significant increase in the yield of wheat and rice was confined to Punjab, Haryana and Western Uttar Pradesh in north-west India. (Subrahmanyam and Sekhar, 2003). During the period of 1970s the green revolution spread to new areas like coastal Andhra Pradesh and Tamil Nadu, eastern Utter Pradesh and some part of Rajasthan. However, the spread of green revolution was not homogenous for all the states. Thus the overall crop output at all India did not witness a significant increase in the growth rate[2]. The period of 1980s appeared to be the best period for Indian agriculture with significant acceleration in output growth and reduction in regional inequality because of the introduction of the HYV seeds for other crops[3], spread of green revolution to eastern part[4] and emphasis on watershed programmes in dry areas (Subrahmanyam and Sekhar 2003). But the increased state involvement in the provision of inputs led to a fiscal crisis during the 1990's. The fiscal crisis led to a change in public policy wherein the state withdrew from investment and/or provision of subsidized inputs and assigned itself the role of facilitator of production in the economy. Again the period of 1990s witnessed decline in the growth rate of the crop output and income[5].

After nearly fifty years of Independence, Indian agriculture did witness increased performance as compared to the pre-independence period. But a remarkable systematic

[2] Specific crops like rice and wheat witnessed increase in the yield and output but the over all growth rate of total crop output has declined in the period 1968-85 to 2.63 percent compared to the 3.02 percent in 1950-65 at all India level [(Rao Ray and Subharao (1988) and Rao and Deshpande (1986)].

[3] In the 1980s the new technologies spread to some other crops like cereals, rapeseed and mustard, soybean, sunflower, cotton and sugarcane etc

[4] In 1980s there was spread of green revolution towards eastern Indian states of Bihar, West Bengal, Orissa and Assam.

[5] The growth rate of gross domestic product (GDP) from agriculture declined from 4.2% in the 1980s to 3.7% per annum in the 1990s (Economic Survey 2001). Again the GDP from agriculture witnessed decline in the growth rate to 2.02% in between 2000-01 to 2004-05 (Mathur, Das and Sircar 2006).

result on the studies of the performance of agricultural sector is that states perform differently. Some states grow faster and some do not grow fast while some states witness a decline in the rates of growth. There exist three interrelated sets of literature analysing the growth performance of the states. One is related to the analysis of growth of crop output or income over time in the different states[6] [Srivastava (1993), Sawant and Achuthan (1995), Shand and Bhide (2000)]. The general conclusion that emerged from the past studies is that the growth patterns of states are not similar with regards to the yield per hectare, output and income. For example the study by Chand, Raju and Pandy (2007) established that the growth rate of agricultural Net State Domestic Product (NSDP) was above 2% in the states like Bihar, Punjab, West Bengal, Andhra Pradesh and Haryana in the period 1995-96 to 2004-05. On the other hand, the growth rate of agricultural NSDP was below 1% in the states like Rajashtan, Maharashtra, Orissa, Gujarat, Karnataka and Assam for the same period.

The second set of literature analysed whether regional differences are decreasing or not. One of the important objectives of the state led planned development process was the reduction in regional inequality. Though state through its instruments like investment and introducing new technology, aimed at reducing the inequality it was observed from the past studies is that the degree of regional disparity in agricultural development has been very high in term of income from agriculture [Alagh (1980), Dev (1985), Bhalla and Tyagi (1989), Marjit and Mitra (1996), Bhalla and Singh (1997), Rao, Shand and Kalirajan (1999), Bhattacharya and Sakthivel (2004)].

The third set of literature analysed whether there is convergence of rate of growth of income in the different states. The literature suggested that there was no evidence of convergence among the states with respect to the per capita net state domestic product

[6] The growth rate of Net State Domestic Product (NSDP) from agriculture in the period 1970-71 to1980-81 was higher in Gujarat, Maharashtra, Assam, West Bengal, Punjab, and Haryana (the growth rate varied between 3 in Haryana to 5% in Gujarat). Utter Pradesh, Madhya Pradesh, Orissa, Bihar, Andhra Pradesh and Karnataka witnessed moderate growth rate in the same period (the growth rate varied between 1.7% in Karnataka to 2.9% in Utter Pradesh). Rest of the states witnessed growth rate below 1% and Tamil Nadu is the only state where the growth rate was negative in between 1970-71-1980-81. All most all the states witnessed increase in the growth rate of agricultural NSDP in 1980s compared to the earlier decade except for Orissa and Assam, where the growth rate has declined (Shand and Bhide, 2000)].

[Marjit and Mitra (1996), (Ghosh, Marjit and Neogi (1998)]. The convergence hypotheses can be tested by σ-convergence, absolute or unconditional β- convergence and conditional β- convergence[7]. The study by Ghosh (2006) calculated the absolute β- convergence and the result shows that there is no significant convergent or divergence in the land productivity and per capita agricultural output, there has been significant divergence in the labour productivity particularly after 1990s. The study also used the σ-convergence and the result shows that after the introduction of HYV seeds the per capita agricultural output increased significantly. The analysis of inter-state variation using the club convergence and unit root test shows that states like Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh share a common steady state path with all India. Other states like Haryana, Punjab, Kerala, Orissa, Tamil Nadu and West Bengal are diverging from the national average steady-state path. Another study by Mukherjee and Kuroda (2002), examined the convergence hypothesis by using the total factor productivity (TFP) of agriculture in the states. The study divided the states into two groups as high performing states and low performing states according to the growth rate of TFP considering 1970 as the base year. The result suggested that the there is no evidence of a reduction in the productivity gap between the two groups of states over time. Study by Dagupta, Maiti, Mukherjee, Sarker and Chakrabarthi (2000) suggested that there was no evidence of β- convergence across states with respect to the per capita State Domestic Product (SDP) for the period 1960-61 to 1995-96. The σ-convergence showed that the states diverge in terms of their per capita agricultural output but converge in terms of infrastructure.

[7] The concept σ- convergence concerns with cross sectional dispersion of per-capita income. This convergence is said to be exist if the dispersion of per capita incomes across regions decreases over time. The existence of σ- convergence implies a tendency of per capita income to be equal across regions over time. Whether the presence of σ- convergence in per capita income is due to higher growth rates of the poor regions can be explained by β- convergence. Absolute β- convergence is said to exist if the poorer regions tend to grow faster than the richer ones. The existence of absolute β- convergence is empirically examined by estimating cross sectional regression of annual average growth of per capita income on the initial level of per capita income. The absolute β- convergence assumes poor regions will grow faster than the rich ones depend on the key assumption that the regions differ in their levels of capital only. But regions my differ in many other respect like investment, rate of capital depreciation, population growth rate, literacy etc. These difference may generate different steady state for different regions. In different steady states for different regions one can test the conditional β- convergence, holding the steady state of each regions constant. Conditional β- convergence is perceptible only after other factors, which may cause variation in steady states across regions are accounted for.

1.1 Factors Influencing the Performance of Agricultural Sector at the State Level:

The factors affecting the increase in the differential growth performances in the agriculture was divided broadly into four categories based on the past literatures. The first set of factors is the difference in the natural conditions, the second set of factors that identified in the literatures is the difference in the state policy. The state policy can take with respect to the land reform measures or by public investment in agriculture in terms of provision of irrigation facility or by introduction of new technology i.e. the green revolution. The third set of factors that can lead to the differential performance of states is by increase in the private initiative and investment in the form of crop diversification and expansion in well irrigation. Fourthly another set of literature identified the difference in the initial condition in terms of land settlements in colonial period, which affects the present day performance.

i Natural Factors:

The disparities in agricultural development have often been attributed to inter regional variations in agro-climatic conditions and resource endowments (Ghosh, 2006). In different regions the natural factors like soils and climatic conditions are fixed and the production technology has to adjust with them. The natural factor like the difference in the amount of rainfall received in different states is different. According to Chand, Raju and Pandey (2007), amount of rainfall is one among the important factor that affects the performance of agriculture thus leading to differential growth performance among states.

ii State Policies:

The state policy can lead towards an increase in the difference of the growth rates among states. Agriculture is a state subject and the performance of the agriculture mainly depends on the individual state's policy. It has pointed out by Srivastava (1993), that the dynamics of change in the regional disparities of agricultural development would depend on the nature of the regional distribution of gains from economic reforms. The state policy can take the form of the implementation of the land reform, public investment in the form of

irrigation and the introduction of the new technology i.e. In Indian case, green revolution in agriculture.

Land Reform: Land reform is a measure adopted in order to correct the uneven distribution of land and to provide the private property rights on land. Different Indian states had different land settlement system imposed by the British policy. The demographic and economic factors, together with the differential impact of rent-revenue on different cultivators created a ground for regional difference in the pattern of surplus appropriation and the extent of economic differentiation among the peasantry (Srivastava 1993). After independence Indian states implemented land reform at the all India level but the impact of land reform showed mixed results. In Kerala, West Bengal and Karnataka the reform measures significantly influenced the agrarian structure. But regions like Bihar, Orissa and Rajasthan witnessed only a marginal impact of reform measures (Suri and Raghavulu 1994).

Public Investment in Irrigation: Even after the post green revolution period ,the difference in public investment in agriculture was considered as the prime factor for analyzing the regional diversity among the states. The difference in the rate of investment largely attributed to a difference in the rate of domestic savings (Kalirajan and Shand 2006). The high productivity states like Punjab, Kerala, Tamil Nadu, Haryana, West Bengal, Uttar Pradesh, Assam and Andhra Pradesh were characterized by high levels of area under irrigation during 1992-95. The similar view was pointed out by Rao, Shand and Kalirajan (1999), that both public investment and private investment has bearing on the regional disparity among the states. (Alagh 1980). Nath (1970) stated that some states shows increase in productivity like Punjab, Haryana and Tamil Nadu, where the proportion of irrigated cropped area are high. In other states like Gujarat and Maharashtra the share in irrigation was low.

Green Revolution: The implementation of green revolution was different from different states. With the introduction of the green revolution the regional disparity of the productivity has increased (Yechuri 1976, Bhala and singh 1997, Mukherjee and Kuroda

2002, Banerjee and Iyer 2004, Ghosh 2006). The emphasis of the new technology was obtaining larger output of foodgrain along with achieving food security. The impact of technological change was felt through out the country, but more vigorously in few states and in case of few crops (Parayil 1992). The states reacted to the technological change differently because the flow of new technology was different for different states. During the mid sixties the new seed fertilizer technology was confined to the irrigated area of Punjab, Haryana and Western Uttar Pradesh in north-west India. During the period of 1970s the green revolution spread to coastal Andhra Pradesh and Tamil Nadu, eastern Utter Pradesh and some part of Rajasthan. The spread of green revolution was late for the eastern Indian states. The new technology is highly irrigation intensive, thus the HYV seeds was initially adopted on a large scale in the irrigated area of Punjab and Haryana, and recorded significant acceleration in crop output of those region. Not only did the states enjoy a high proportion of area under irrigation but also less burdened by the deadweight of pre-capitalist exploitative relationships.

iii Private Initiative and Investment into Agriculture:

The third factor that can lead to the differential growth performances among the states is the private initiative into agriculture. Pattern of private investment is the major determinant of economic growth (Alagh 1980). Private initiative can take the form of diversification of the production from foodgrains towards the high value cash crops or investment in irrigation i.e. well irrigation**.**

Crop Diversification: The level of diversification of crop enterprises reflects the extent of economic development in the rural sector. Crop diversification led to the increase in the farm profitability as well as to help avoiding risk and uncertainty due to climatic and biological vagaries (Hazra 2001). At all India level, out of total growth in per hectare value of crop output, at least 27 percent was contributed by the shift in the cropping pattern towards high value crops in between 1980-98. During 1980-81 to 1998-99, there was considerable increase in crop diversification in West Bengal, Assam and Maharashtra. There was also a marginal increase in crop diversification in Karnataka, Gujarat, Rajasthan

and Andhra Pradesh. In other states there was a decrease in the degree of crop diversification between the 1980-81 to 1998-99 (Acharya 2003). Thus the difference in the private initiative inorder to under take the investment also helps to increase the regional variation in agricultural performances.

Well Irrigation: The investment in the private irrigation system like well irrigation also led to the differential growth performance of the states. For example in the wheat regions the introduction of new varieties, the expansion of irrigated area and improvement in quality of irrigation through the use of tube-well, led to substantial increase in production (Easter, Abel and Norton, 1977).

iv Initial Condition in the form of Land Settlements:

Another factor that affects the regional difference in agricultural performance is the growth at the initial period. The pattern of institutional development in the history influences the growth performances at the present day (Banerjee and Iyer 2004). The historical arrangements like land distribution pattern and public investment at the colonial period led to the differences in the distribution of wealth among the states. British policy gave importance on the imposition of land revenue for the maximization of surplus over the time period. The revenue demand was high in the east region of India compared to the Mahalwari region of Punjab and the Royatwari region of Madres province. The narrow base of a surplus owning peasantry in the east was contrasted with the relatively prosperous base of the middle-rich peasantry in the north-west, due the difference in the land revenue, public investment in irrigation, road and electricity. Public investment of British India concentrated particularly in irrigation, chiefly in area where gains in productivity could be fly off as additional revenue, viz. North-West, Bombay and Madras provinces. For example out of total gross public investment on irrigation, 47% was in Punjab, 18% in Madras provinces, 14% in Bombay, 8% in united province and only 11% in other areas in the period 1898-99 to 1918-19. (Thavaraj 1972).There was large and significant difference in the measures of agricultural investment and productivity between landlord and non land lord areas in post independence period (1957-87) (Banerjee and Iyer,

2004). The landlord states are classified as Bihar, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and West Bengal and the non land lord states are Andhra Pradesh, Assam, Gujarat, Karnataka, Kerala, Maharashtra, Punjab and Tamil Nadu. The study shows that non landlord districts have 24% higher proportion of irrigated area and 43% higher levels of fertilizer uses. They have 27% higher proportion of rice area and 18% more of wheat under high yielding verities. Overall agricultural yield is 16% higher, rice yield being 17% higher and wheat yield 23% higher in the non landlord regions compared to the landlord regions. According to the study, the major difference arising between the landlord and non landlord regions is the difference in the public spending. On an average, the landlord regions spend 13 rupees per capita on development expenditure in between 1960-65 whereas the non-landlord region spent 19 rupees per capita in non land lord districts. The difference again widened after the introduction of new technology when the landlord states spent 29 rupees per capita while the non landlord states spent a much higher amount of 49 rupees per capita.

The different type of factors identified by the past studies assumes the structure of all the states economies to be similar thus analysing the performance of the state economies Different states can have different combinations of structure.

1.2 Importance of Structure in Studying the Performance of States:

One can broadly identify two economic structures. One is a market-oriented structure and the second is the non-market or traditional or pre-capitalist structure. One can identify three broad features, which separate the two structures. They are: the production, distribution of knowledge, nature of exchanges between agents.

In a traditional economy production of knowledge is not a conscious action of agents but more a reflection of randomness. “The knowledge that is use for the farming is known by the farmer for long generation. “The farming community hardly practices any new methods either by trail and error or from other sources” (Schultz 1972). Thus the risk and uncertainty was low and it arises only when the transformation gets under way. The state

of skill is known in case of traditional agriculture and the supply price of reproducible factors rises as the quantity of these factors increases.

The production in these traditional economies is for home consumption. The mode of production in a traditional system can be explained by the underdevelopment of market in a small isolated community, in which gains from the division of labour based on market are severely limited. The niggardliness of agriculture in poor communities is frequently attributed by cultural values. There is lack of saving and stagnant in agricultural community and this is the consequence of the cultural characteristic of the farm people in these communities (Schultz 1964).

On the other hand in a modern economy production is a conscious action of agents and is called science based. The modern or the scientific agriculture includes the scientific knowledge on physics, chemistry, biology and also engineering, with respect to irrigation and transport facility and agricultural machinery. The use of new scientific inputs requires efficient economic incentives, adequate information and learning of new farming skill (Schultz 1976). The transfer of knowledge is inter-generational in a traditional economy while in a modern economy it is market mediated (Shultz 1964). In a traditional economy the exchanges are personal with an absence of markets for the inputs and production is organised for self-consumption. In the traditional village environment, the decentralized system of independent peasant produce tied by personalized exchanges called as "personalized market" (Hayami 1981). But in a market oriented economy the exchanges are mediated by the anonymous market and there exists markets for input as well as output**.**

A market economy can generate higher levels of performance (growth) when compared to the traditional economy. The higher performance could be due to demand side or supply side factors. A market economy which induces higher levels of specialisation and division of labour generates a higher demand for goods and services produced in the economy. This could result in specialisation at the micro level and crop diversification (to high valued crops) at an economy level, which can induce higher levels of performance of the economy. On the supply side, improvements in sciences can get embodied in

improvements in input usage in agriculture leading to better performance of the economy. In this case, technology substitutes for land and the performance (growth) thus depend on the modern technologies. The performance of the economy to a large extent depends on the levels of specialisation and the technology used in the production process. In contrast in a traditional economy, which is repetitive in production systems, the performance gets defined in terms of the 'natural' conditions and the extent of land under cultivation.

In developing countries like India, the process of agrarian transformation is incomplete. In other words the market economy is not the dominant structure in Indian agriculture. This could be identified as the co-existence of dual economies (Stiglitz 1998) or in terms of co-existence of multiple modes of production. In the India situation, the markets for primary inputs are not completely formed. The land market is said to be an inactive market. The land market witness few transactions. In addition, small farmers are said to be more 'efficient' farmers but the land market does not facilitate transfer to the small farmers (Vyas 2003). In the same vein, there exists surplus labour existing in agriculture and the labour market is also said to be incompletely formed**.** According to Bhaduri (1984) the inadequately formed labour market is the basic postulate for backward economy. In addition, the literatures of contractual forms existing in Indian agriculture also show that personalized exchanges are decisive in explaining the 'stylised facts' in these economics.

The agrarian transformation is incomplete among the Indian states. But different states may have different structures. Even under conditions of incomplete transformation of the Indian economy, the states are not similar in terms of the relative importance of market economy. The importance of the market economy could be different in the different states. Some states may have structure that is conducive for the growth and individual might have incentive to change, and thus perform better. In these economies where the market economy dominates and the individual has the incentive to change, the demand for product is more and the producer has an incentive to produce. But some structure may constraint the individual to initiate change that affects the overall performance adversely. In such a system wherein the markets are not completely formed, the initial allocation of resources

influence on the performance of the economy. In these economies the performance is constraint by the structure from both demand and supply side.

1.3 Objective of the Study

The study attempts to analyse the impact of structure on performance in terms of the effect. It tries to understand the performance of the agriculture and thus analyse the cause for the differential performance among states. Thus the study analyses the effect to the cause. If the 'modern inputs' and crop diversification significantly influence the performance of the state economy, we presume that market-oriented economy is relatively more important in the state. But if land and nature based factors influence the performance of the economy we presume that traditional economy plays an important role.

In this context the study would like to analyse the following objectives.

i. The first objective is to find the phases in the agricultural performance of two states.

ii The second objective analyses the factors accounting for the breaks and whether it is land based or yield based or crop diversification based. .

iii. The third objective analyses the factors accounting for growth and whether the factors are land based or modern inputs based, for each phase in the two states.

iv. The fourth objective analyses the year to year fluctuations in the agricultural sector and analyses whether the cycles are land based or modern inputs based, for each phase in two states.

Two adjoin states, Andhra Pradesh and Orissa are taken into consideration to analyze the agricultural growth performances over the period of time. Orissa is generally considered as a low income state (total net state domestic product was 67090 crore in 2005-06) whereas Andhra Pradesh is a relatively higher income state (total net state domestic product was 204312 crore in 2005-06). On the basis of growth rate, Orissa is considered as a low

growth state among the Indian states (the growth rate of agricultural NSDP was below 1% in 1995-96 to 2004-05) but the growth rate on agricultural NSDP was above 2 percent in Andhra Pradesh for the same period (Chand, Raju and Pandy 2007).

1.4 Indicator Used to Study the Performance of Agriculture:

Several attempts has been made to analyze the growth of agricultural sector incorporating indicators like total crop output [Mukhopadhyaya (1976), Bhalla and Singh (1997), Ramasamy (2004), Rath and Jena, (2006) Mathur, Das and Sircar (2006)], food crop output [Dev (1987), Ranjan (1997), Singh, Raj and Karwasra (1997), Singh, Singh and Shrivastava (2005)], capital formation and state income from agriculture [Subrahmanyam and Sekhar (2003), Bhattacharya and Sakthivel, (2004), Chand, Raju and Pandey, (2007)]. The Present study considers net income from agriculture as the indicator to examine the agricultural growth rate over the period. The study makes an attempt to understand the aggregate performance of agriculture in two states, thus the aggregate income of the sector has been considered.

The use of the income data has its own limitations. There are two sources of collecting the State Domestic Products (SDP) estimates. The first is the comparable estimate made by the Central Statistical Organisation (CSO). However this series is available only from 1967-68 to 1985-86 and that being only in current prices. The alternative is to use the estimate of SDP made by the statistical bureau of each state. These figures are not comparable across the states though the states follow a broadly uniform approach and methodology (Rao, Shand and Kalirajan 1999). There are two arguments for using these figures. First, they are the only estimates available in a long time series. Second, a study by Das and Barua (1996), which estimated inequalities using both the series obtained almost identical results and therefore concluded that “regional accounting variations are only minor from the viewpoint of inequality measure”. The concept of SDP only indicates the income originating in different states and does not represent total income accruing to them. However there are estimates of net factor income accruing to a state from outside its boundaries, so it not possible to take these into account.

1.5 Sources of Data:

The data regarding Net State Domestic Product (NSDP) in agriculture was collected from the Director of Economic and Statistics of the respective states. The period of analysis is from 1960 to 2005. The NSDP in agriculture in constant prices is taken into account rather than current prices. The current prices over the time do not reveal actual economic growth because it contains the combined effect of the changes in volume of goods and services and the changes in the prices of goods and services. In order to eliminate the effect of price changes or inflation the estimates of state domestic product are prepared by evaluating the good and services at the prices prevailing in the base year known as estimates at constant (1993-94) prices. The base year is shifted to the more recent base with a view to capture realistic growth of the economy and to show a meaningful analysis of structural changes in the economy.

Agricultural income is dependent on a set of exogenous and traditional factors like rainfall and weather as well as endogenous factors like irrigation and new technology. The sources of data collection of these factors are presented here.

The data on rainfall for Orissa and Andhra Pradesh is collected from Statistical Abstract of the respective States. The data on rainfall in Orissa is available in terms of actual and normal rainfall for the year. This study considers the actual rainfall of the state for every year. The data on rainfall in Andhra Pradesh is available in terms of monsoon and post monsoon rainfall for each year. The rainfall received in monsoon and post monsoon period is added together to find out the total rainfall received in a year in Andhra Pradesh.

Land use cultivation is one among the important factor that affects the income level. The data regarding the land use pattern in Andhra Pradesh and Orissa was collected from the Statistical Abstract of the respective States. The total land in a state is divided into different types like- (i) land under forest, (ii) Area not available for cultivation, it again include (a) barren and uncultivable waste (b) land put to non agricultural use, (iii)

Cultivable west, (iv) Land under miscellaneous tree crops, (v) Permanent Pasture and other grazing land (vi) Fallow land it include (a) Current Fallow (b) Other than Current Fallow, (vii) Net Area Sown (viii) Area Sown More than Once, (ix) Gross crop area. The total land available for cropping is again divided into net sown area and area sown more than once. The category from 1 to 5 is not used for the research work. The study mainly concentrates on the area under agricultural uses and the fallow land because these two categories have a direct impact on the agricultural production.

The crop area which kept as fallow during the current year is called as "current Fallow", for example if any seeding area is not cropped again in the same year it is treated as current fallow. Fallow land "other than current Fallow" refers to the lands which are taken up for cultivation but are temporarily out of cultivation for a period of not less than one year but not more than five year. The reason for keeping fallow can be either poverty, inadequate supply of water or malarial climate or silting of canal and rivers.

Net Area Sown (NSA) represents the area sown with crops counted only once in the same year. Area Sown More than Once (ASMO) refers to area on which crops are cultivated more than once during each agricultural year. This is obtained by deducting net area sown from gross crop area. Gross Crop Area (GCA) represents area covered under crops, including both areas under net sown as well as area under double cropping. This is the sum total of the area covered by all individual crops.

The data regarding Irrigation sources was collected from statistical abstract of respective states. The Directorate of Economics and Statistics in Orissa, presents the data regarding irrigation potential created in the state. Three main sources of irrigation in Orissa i.e. major and medium irrigation, minor irrigation (which is divided into lift irrigation and flow irrigation) and the third one is other sources. Depending on the size of cultivable command area (CCA), irrigation projects are classified as major (above 10,000 ha), medium (between 2000 ha to 10,000 ha) and minor (between 40 ha to 2000 ha. On the other hand in Andhra Pradesh the sources of irrigation represents , irrigation through Canals, tanks, wells and other sources.

The data regarding consumption of fertilizers in Andhra Pradesh was collected from Fertilizer Statistics of the state and for Orissa, the data is collected from the Statistical Abstract of Orissa fertilizers includes Nitrogen, phosphate and potash, all three combined together gives the total consumption of fertilizer in the state. The data regarding area under HYV seeds was collected from Department of Agriculture of Andhra Pradesh. Area under HYV seeds in Orissa is available in Agricultural Statistics of Orissa, Directorate of Economics and Statistics.

The amount of electricity consumption for agricultural purpose in two states was collected from the All India Electric Statistics. The data regarding the total electricity consumption in Orissa was only available from 1975 onwards, whereas the data for Andhra Pradesh was available from 1960-61 onwards.

The change in the cropping pattern is calculated by the share of area under each crop to the total gross crop area. The crop categories are divided into four main categories like area under Foodgrains, Oilseeds and Cash crops and area under Other crops. Area under foodgrains includes all types of cereals and pulses. Area under Oilseeds includes area under groundnuts, sesamum, castor, linseeds, mustard and other seeds. Area under cotton, jute, mesta, sugarcane, tobacco and other fibres constitutes cash crops. Other crops include area under potato, onion, ginger and other vegetables.

1.6 Chapter Outline

The present study comprises of six different chapters based on different objectives of the study. After the first introductory chapter, in the second chapter the structural difference between two states is analyzed. The third chapter makes an attempt to examine the phases in the agricultural income in the two states and the nature of the different phases. Unlike the past studies, an attempt has been made here to understand the different phases endogenously from the data by applying the statistical tool. The sources of agricultural income growth rate in different phases are examined in the fourth chapter. The factors

leading for the growth in agricultural income can be different from one phase to the other depending on the nature of the phases. In the fifth chapter an attempt has been made to analyse the short run fluctuations in agricultural income. The cyclical behaviour pattern of the overall income can be influenced by the nature of the economic structure. The co-movements of the agricultural income and the variables are studied in this chapter. The last chapter presents the conclusion of the study.

Chapter: II

Structural Differences between the Two States

Introduction

In the Indian context, the agrarian markets for the primary inputs (land and labor) are incompletely formed. The land market has a very low turnover and is also identified as an inactive market. The labor market is also incompletely formed with potential labor supplying households entering the lease market and/or small farmer systems getting strengthened in the economy. With the two primary markets incompletely formed in the rural sector, market as a re-allocating system is not able to enhance the performance of the agents and the structure becomes a binding constraint to the performance of the agents in the economy. In other words, the performance of the agents is constrained by the structure of the economy. The present study identifies the structure in terms of the allocation of the resources and the related rights of the agents on the resources. The structure may not be the same for all the units of analysis. The structure of the economy may be similar or different in different states. In some, the individual might have the incentive to change and in the process generate better performance for themselves and by implication for the economy, while some structures might constrain the individual to initiate change affecting the performance of the economy. If the individuals are able to perform better i.e. increase production, the overall economy may also be able to perform better. In this chapter, an attempt is made to identify differences in the structure of the two economies. Emphasis would be on composition of aggregate land and labor resources. The initial allocation or structure can introduce constraints on the agents to expand the production by constraining the demand that exists for the products produced or constraining the supply of goods by the agent. So, this chapter identifies the constraints introduced by the structure to the agents on the demand side as well as the supply side. Nature related factor also creates constraint to the agent. The production and income of individual and the economy depends on the factors like the variation in rainfall, cropping pattern choice made by individual and the investment decision etc.

This chapter attempts to identify the constraints introduced by the structure on the performance of the agent. The present chapter is organized in five sections. The first section

presents some broad indicators of the two states which come under the study. The second section is on the supply side constraints introduced by the structure on the agents while the following section is on the demand side constraints introduced by the structure. The fourth section includes information related to the distribution of rainfall over time in the two states. The last section presents the concluding part of the chapter.

Section: I ***The Two States - Andhra Pradesh and Orissa:***

Andhra Pradesh:

Andhra Pradesh up to the independence was a part of former Madras state and was ruled by the colonial government. The state of Andhra Pradesh was distributed between the British Indian province of Madras and the princely states of Hyderabad, ruled by the Nizams. The princely state of Hyderabad itself had lowest indices for human development in south. Telangana district continued to be under the pre British stage of anarchy under the heels of the despotic rule of the Nizam and was not part of Andhra Pradesh when the state formed for the first time in 1953. Andhra Pradesh was the first state to be formed on the basis of the language. The telegue speaking people were given 21 districts out of which 9 in Nizam's documentation and rest in Madras presidency. The districts under Nizams were added in 1956 to form enlarged state of Andhra Pradesh.

Andhra Pradesh is the fifth largest state in the country both in terms of area and in terms of population. It has the area of 2.75 lakh sq.km forming 8.4% of the total geographical area of the country and 7.62 crores of population (Statistical Abstract of Andhra Pradesh 2005). The state bounded by Bay of Bengal in the east, Orissa, Chattisgard and Mahasrashtra in the north, Karnataka in the west and Tamil Nadu in south. The state has long coastal line of 960km. running from Ichapuram in srikakulam district in the north to Nellore district in south. Andhra Pradesh is popularly and rather appropriately referred as river state. There are 34 rivers in the state including both major and minor.

The state has a tropical climate with moderate diffusion to sub-tropical weather. Humid to semi-humid conditions prevail in the coasta1 area while arid to semiarid situations

pronounce in the interior parts of the state. The state has been divided into seven agro-climatic zones according to the amount of rainfall being received. The zones are Krishna Godavari Zone, Southern Zone, south-Teleangana sone, High Altitude and Tribal Area, North Coastal Area, North Telengana Zone and Scare Rainfall Zone of Rayalaseema. Andhra Pradesh receives rainfall both from the south west as well as north west monsoon. The average annual rainfall ranges from about 74cm in south to about 200cm in the north with considerable fluctuation (Rao, Acharya and Swaminathan, Andhra Pradesh at 50s 2001). Rayalaseema region is a zone of scare rainfall, with an annual average of 69cm. Mahabubnagar and Nalgonda district in Telengana receives the lowest rainfall of 75cm. The coastal area receives the highest average rainfall, of about 102cm.

The red soil covers about two-third of the state land area. The red soil is generally deficient in organic matter. It is rich in phosphoric contents and poor in plant nutrients. The moisture holding capacity of the red soil is poor so irrigation is necessary to cultivate good crop. The second largest portion of the soil is covered by black soil which occupy about one-fourth of the total land. The black soil retains moisture and is suitable for cotton cultivation.

The total population in Andhra Pradesh was 7.58 crores as per the 2001 census compared to 3.59 crores in the 1961 census. The population density also increased from 131 per square km to 277 per square km in 2001 census. The percentage of urban population increased over the period in Andhra Pradesh. The share of the urban population to the total population in the state was 17 percentage as per the 1961 census and it increased to 28 percentage in 2001 census. Thus there was decline in the share of rural population in the state. Rural population was 83 percentage of the total population in 1961 census, which declined to 72 percentage in 2001 census. The importance of the rural economy being high, the agricultural sector is one of the dominant sectors in the economy. In 1960-61, the income from primary sector constituted 65 percentage of the total net income of the state. Out of the total income generated from primary sector, agricultural sector alone contributed 55 percentage of the total income. The contribution of the secondary (industry) and tertiary (services) sector was only 11 and 24 percentage respectively in 1960-61. This shows the importance of the agricultural economy in the state. There was significant change in the income from different

sectors in Andhra Pradesh over the period. The contribution of the income from primary sector to the total net income was 29 percent in 2005-06 where as agriculture sector alone contribute around 24 percent of income to the total net income of the state. The share of the income from tertiary and secondary sector was 50 and 21 percent respectively. This shows there was increase in the importance of the income from service sector in the economy and decrease in the importance of the agricultural sector with respect to the income generation. But the share of the workers engaged in the agricultural sector did not witnessed significant decline over the period. The share of workers engaged in the agricultural sector was around 62 percentage in the state in the 2001 census compared to 68 percentage in 1961 census (Statistical Abstract of Andhra Pradesh 2005).

According to the human development index, the value of education index in Andhra Pradesh was 0.53 and the rank was 13th, the value of life expectancy index was 0.67 and the rank was 8th, and the income index was 0.51 and the rank was 8th among all the states in India. Total human development index value of the state was 0.57 and the rank was 9th in India (National Human Development Report 2001).

Orissa:

In the colonial period Orissa was pre-dominantly under the princely states. There were twenty six princely states in Orissa, formed integral parts of Orissa from geographical, historical and cultural points of view. In the past most of them ruled by “Samanta Rajas” or tributary chiefs of the Gajapatis of Orissa. Balasore, Cuttack and Puri districts were captured by British from the Marathas in 1803 and remained parts of Bengal till 1912 and thereafter it became a part of province of Bihar and Orissa. Under the British rule for a long period the states had been politically and administratively linked with the Moghulbundi districts of Balasore, Cuttack and Puri, which were directly administrated by British. Southern Orissa (Ganjam) was conquered by the British from the Nizams of Hyderabad in 1759 and thereafter remained a part of the Madras presidency till 1936. Sambalpur annexed by the British in 1849 and remained a part of the central provinces till 1905 (Pradhan 2006). The residence of the princely districts remained in a backward and suppressed condition due to

the misrule of their chief. On the other hand the Moghulbundi districts enjoyed the better administration and opportunities for educational and material advancements. The peasantry had no land rights in the princely states. In 1933 the tributary states were brought under the direct control of the government of India. That year eastern state agency, consisting of twenty six Orissa states and fourteen states of central provinces was created the agency, to be administered by a resident who was under the control of the political department of the government of India. This arrangement prevailed till the independence of the country. Orissa as a separate state came into existence on 1st April, 1936.

Orissa is one among the poor state in India. The state comprises of 4.74% of India's population in 2001 census. It covers the area around 1.5 lakh sq. km which is almost 4% of all India (Orissa Development Report 2001). The state bounded by the state of west-Bengal on northeast, Jharkhard on north, Chhatishgarh on west, Andhra Pradesh on the south and Bay of Bengal on the east.

The agro-climatic condition is extremely diverse in Orissa. The state has been divided into four agro-climatic zones- Coastal plains, Central table land, Northern plateau, Eastern Ghats. For even more simplicity it can be talk like Orissa Coastal region and Orissa highland region. The average rainfall in Coastal region is 1500mm with moderate variability. The variability is due to the fact that rainfall is associated with depression from Bay of Bengal. The climate of high land region is mainly high temperature in most parts and medium high rainfall.

In the state as much as 45% of area the soil is red loam and sandy variety and another 35% is of mixed red and yellow variety. Thus there is predominance of light textured red soil in the state. Fertile alluvial soil accounts for only a little more than 4%of the area[1]. In terms of relative soil quality index Orissa position is the lowest among the 17 major Indian states.
The total population of the state was 1.75 crores in 1961 census and increased to 3.68 crores in 2001 census. The density of the population was 111 per square km which increased to 236 per square km in 2001 census. The state of Orissa witnessed the dominance of the rural

[1] Orissa Development Report (2004). Nabakrushna Chaudhury. Center of Development Studies, Bhubaneswar.

economy higher than Andhra Pradesh. In the 1961 census around 93 percentage of population was staying in rural areas and only 7 percent was living in urban areas. Over the period there was not much change in the population structure of rural and urban areas. In 2001 census only 15 percentage of total population stay in urban areas and round 85 percentage of population live in rural area. This shows even in 2001 census a major chunk of population live in the rural areas in Orissa. Agriculture is one among the main occupation in Orissa. In the state around 70 percentage of population engaged in agricultural sector in the 2001 census (Economic Survey 2005). There was hardly any change in the workforce engaged in agricultural sector in the state. In 1961 census around 73 percentage of population was engaged in agriculture it declined marginally to 68 percentage according to 2001 census. The income originating from agricultural sector constituted around 54 percent in 1960-61. The primary sector was the main sector in 1960-61, contributing around 63 percent to the total income. The secondary and tertiary sector contributed around 14 and 23 percentages respectively to the total net income. There was significant increase in the tertiary or service sector in the economy. The income originating from agricultural sector in 2005-06 was 39% to the total net income of the state. The share of income from industry and services sector was 16% and 45% respectively. In Orissa the industry sector was less developed compared to the other sectors.

The state of Orissa witnessed education index of 0.56 and the rank in all India was 12th. The value of life expectancy index in Orissa was 0.58 and the rank was 13th. The value of income index in the state of Orissa was very low with 0.40 and the rack was 15th. The total value of human development index in Orissa was 0.40 and the rank was 11th (National Human Development Report 2001).

Section: II ***Supply Side Constraints Introduced by Structure on the performance of Agents:***

A supply side constraint is one wherein the agents want to expand their production but does not expand it as they feel that they will not be able to appropriate the returns from their 'effort' of expanded production. In the literature this is generally identified as the 'incentive' problems to the agents. The study identified three sets of supply side constraints generated by the structure on the agents. The first set of supply side constraints is related to the land resource. Given that land market as a re-allocation system is under-formed, in this case the allocation of land to the individuals becomes constraint on the performance. The related question is on the nature of rights of agents on the resource land. Is the land allocated to cultivators or to non-cultivators? If the land is initially allocated to non-cultivators, there always exists a disincentive to invest in these economies. If the economy has a larger proportion of non-cultivators owning land compared to another economy with a smaller proportion of non-cultivators owning land then the economy with smaller proportion of non-cultivators may be able to perform better. The second set of supply constraints is the proportion of households who are part of the economy which is relatively close to the outside economy, here state economy. An indicator of the proportion of relatively closed households is the proportion of tribal population in the economy. In a tribal form of organization of production, user right-based method of production with personalized exchanges dominating the form. The system does not have individual private property right but a user right based system of organization of production with continuity of the user right on resources. An individual in this form of organization has different calculus of organization of production, which is not conducive to generate higher levels of output and growth in the system. So, an economy with a larger allocation of resources to tribal economy would also face constraints on growth. The third aspect is the allocation of labor between workers and non-workers. A larger proportion of non-workers in the economy would imply a larger share of output being distributed to consumption and by implication a lower proportion of output being used for investment purpose.

2.2.1 *Land Settlement and Land Reforms:*

The important condition for the generation of land market in the rural sector is the initiation of individual private property right regime in the economy. This to a large extent depends on the nature of land settlement inherited from the colonial rule and the nature of land reforms, which attempted to introduce individual property rights regime on land under conditions of inactive land market. A land settlement may generate individual property right regime on the land and if individual property rights do not exist land reforms may correct the distortions generated by the land settlement process by generating individual private property on land.

The colonial policy with respect to land revenue, initiated a process of land settlement which formed the basis for the identification of private property right on land in the post colonial period. The land settlement process, in the colonial context, identified the individual who had the liability to pay land taxes to the British colonial government. Generally, three types of land settlement systems are identified in the Indian context in the British ruled areas[2]. A landlord based system (example Zamindari, Inamdar etc), wherein the landlord is expected to pay land revenue to the state and in turn the landlord had the right to settle (and unsettle) people on the land under their jurisdiction. A second method of land settlement is the Ryotwari settlement where the revenue payments was on individual who may be also be a ryot. The third system is the Mahalwari system, wherein the revenue payment was the responsibility of village bodies who jointly owned the villages. The areas, not under the direct control of the British rule, had land settlement similar either to the landlord based or to the non landlord based system. The Ryotwari system of land revenue collections is the closest approximation in the Indian context to the individual property rights on land. The landlord based system generated a series of intermediaries between the cultivators and the State a by-product of the land settlement process introduced by the colonial government. One of the implications of the existence of intermediaries was the lack of incentive to invest by the cultivators affecting the rates of growth of the agrarian economy. The areas with Ryotwari system or non-landlord based land revenue system have a higher agricultural investment and productivity even in the post-colonial period and differences in the performance are due to differences in historical institutions leading to different policy

[2] The reason and condition for the different land settlement process in the Indian context is outside the preview of the paper and a explanation could be found in Banerjee and Iyer (2004) and Besley and Burgess (2000).

choices (Banerjee and Iyer, 2004). The land settlement process identified the individual who was responsible to pay land revenue to the state in the colonial period but in the post colonial period was used as an indicator of property right of land. In the post independence period the state initiated measures to generate individual private property right regime on land. These measures are generally called the Land Reform policies. The policy on land reform was evolved by the government at a central level in the fifties. The first authoritative outline of a national policy of land reform, including a ceiling on agricultural holdings, was clearly set out in the first five year plan. The land reform usually reflects a public policy of redistribution of land for the benefit of landless labourers, tenants, and small farmers with a view to securing a diffusion of wealth, increase in income and productive capacity. But in India, land reform was carried out under a condition of agricultural over population and shortage of land, coupled with uneven distribution of land. The initial trust of land reform in all states was on the elimination of the intermediary interest in land. The Land Reform policies attempted to remove the intermediaries between the state and cultivator and generate individual private property right regime. In contracts where this was not possible, the measures wanted to regulate the tenancy contracts. Different states had combinations of land settlement process and also the impact of land reforms was different in the states.

Land Settlement and Land Reforms in Andhra Pradesh:

The principal form of land settlement system in Andhra Pradesh was the *Zamindari*[3], *Inamadari* and *Ryotwari* in coastal Andhra, *jagirdari* and *diwani* in the Telangana region. In the Andhra region the *Zamindari* system encompassed over 50 percent of land. Out of the total area of 27,493,976 a, in Andhra's coastal districts of Vishakhapatnam, Godavari, Krishna, Guntur and Nellore, 14,199,844a, of land were under *Zamindari* tenure. The *Inam* area comprised a total of 2,102,431 a, in these districts (Suri and Raghavulu 1996). The three distinct regions of Andhra Pradesh are, Telangana, Coastal Area, Rayalseema. The Telangana region had a high proportion of tenancy due to the dominance of persistent absentee of landlordism. The coastal irrigated area known as Coastal Andhra were marked

[3] The Zamindari, inamadari, jagirdari were intermediaries between the government and the cultivating peasant.

by high density of population and ownership of land has generally been restricted to less than half of the household and large workers existed. The Rayalseema region which is a part of Andhra area has a high incidence of tenancy and large number of poor owning small plots of land.

The Andhra provincial peasant association resolved in 1931, it aimed to work towards the final elimination of all the *Zamindaris* and intermediaries between the peasants and the government through legislative action. The principal feature of the statutory *Zamindari* abolition act in the Madras Assembly in 1947, that the *Zamindars* were deprived from the right to collect rents from peasant. The power of collecting rent was vested on the government and occupancy peasants were granted permanent proprietary right to the land they cultivated, as under *ryotwari* settlement. The absolute property rights to hundred of acres of the so called *seri* land were conferred on the *Zamindars,* resulting a large scale eviction of the existing tenants.

All most all the *inam* villages in the Andhra region were declared as estate and were taken over by the government under the Estates Abolition Act of 1948, the remaining *inam* villages were not taken over as they were not declared as estate by the civil court. In this the legislation *inamdars* were given one third share of cultivation of the peasants. Thus the peasants who were the rightful owners and were cultivating those lands since long time were denied *patta* rights for whole extent of the land by them. Another piece of legislation for the abolition of minor *imams* were enacted in the same year. Under these two enactments all imams major and minor were abolished in the Andhra area. So much so except for few estates not taken over by the state and few *shrotriam* villages and *khandrikas* the whole area both the plain as well as in the agency areas has come under the *Ryotwari* system.

The Andhra tenancy act in 1956 was sought to give protection to certain categories of tenants in Andhra region from unjust evictions. This act was provided for the fixation of fair rent. The minimum period of lease was fixed at 6years. The act recognized only written leases. In Andhra area the written leases are very rare. In absence of recorded evidence of the tenants and landlords relationship it is well impossible to establish tenancy, even for a

bold tenant. The tenants were not related with this act in any way, thus this legislation had made tenants apathetic towards the few rights which were conferred to them. After a lot of agitations the state government brought forward two bills in 1961 and 1962. In both the occasions the legislative proposal lapsed on account of the apathy of the government. Another Andhra tenancy act was amended in 1970 instead of unified piece of tenancy legislation for the entire state. But one third of land in all regions of the state was under tenancy. Nowhere the rents fixed by legislation are being implemented.

The Telengana region was under the rule of Nizam of the former Hyderabad state. About 60% of land was under the *Ryotwari* revenue system and balance under the direct control of the Nizam's and feudal lords such as jagirdars, makthadars etc. In the Telangana region of Andhra Pradesh, which was earlier a part of the princely state of Hyderabad, exploitation and oppression were severe in area that had been parceled out with heritable rights by the *Nizams.* The peasants were highly subordinated to the landlord and chiefs and forced labour or *vetti* was common. The peasants of Andhra Pradesh had the unique distinction of lunching militant movement in the Telangana area, and to some extent in the coastal area aimed at restructuring agrarian social relations through direct action against the government. The abolition of intermediaries in the Telangana region came about as a consequence of a peasant struggle.

In the Telangana region during 1944-46, the local struggles were conducted against illegal exactions, levies and *vetti* as well as against eviction of peasants from their land. The Telangana peasant's revolt of 1946 to 1952 may be said to be the forerunner of land reforms in Andhra Pradesh. This struggle was directed against the policies of the *Nizam's* government, such as eviction of tenants, grain tax, and forced labour. In the 3000 villages to which the movement spread nearly 10 lakh acre of surplus land, illegally seized land, leased land, cultivable land, waste land and forest land were distributed with full ownership rights to the rural poor and middle peasants.

The vast extent of land under *serf-e-khas* of Nizam were brought under *Diwani*. The *Jagir* abolition regulation was promulgated by the military government of Hyderabad on

Augest.15. 1949. Therefore all the *jagirs* in Hyderabad state were abolished in a month's time as compared to the prolonged period of ten to fifteen years taken for the abolition of big *Zamindaries* in the Andhra area. The Hyderabad reform committee was appointed to suggest measure to secure fixity of tenure to the tenants to examine the question of imposing a ceiling on the size of agricultural holding. In the report the committee recommended that all tenants who had cultivated a piece of land continuously for a period of six years should be deemed to be protected tenants.

The Hyderabad State Act on 1955 aimed at the abolition of imams except the imams relating to religious and charitable institutions and certain class of service *inamas*. But this piece of legislation was not implemented. The Andhra Pradesh abolition of *inam* at 1967s enacted for the abolition of all *inam*, including *inams* held by or for the benefit of religious and charitable institutions and imams held for rendering service useful to the government and village communities etc.

In Andhra Pradesh the Tenancy and Agricultural Act (1950) brought forward under the impact of the Telangana peasants armed struggle. The act recognized the need to meet the genuine and just demands of the land hungry peasants for equitable distribution. It aimed to regulate alienation of land and to prevent excessive sub-division of agricultural holdings. The act of 1950s underwent many amendments. Both original act and amendment were intended to protect the right of tenants. But the rights were severely qualified which made it very difficult for the tenants to have them implemented (Francis 1996). The extent of land affected by the tenancy reforms was approximately 3.49% of cultivated land (Deininger, Jin and Nagarajan, 2007).

Andhra Pradesh ceiling and Agricultural Holding Act implemented in 1961. In comparison to other states the ceiling limit was very high in Andhra Pradesh. While computing the ceiling area the leased out area held by tenants was not taken into account. In consequence this ceiling legislation was only a ceiling on owner cultivation and not a ceiling on ownership. The surplus areas declared and distributed under this act has not come up to even

one lakh acres. The extent of land affected by the ceiling reforms was approximately 8.34%. (Deininger, Jin and Nagarajan, 2007).

The distribution of the government lands acquired much importance in the land reform programme. The landless, marginal farmers were cultivating the government west land both in Andhra and Telangana without permission. A number of struggles took place for the occupation of waste land and grant of *pattas* for such land which was under cultivation of landless people. From 1969 the government took up crash programme for assignment of waste lands. But the assignment was not completed. During the emergency under the implementation of 20-point economic programme, *pattas* were issued for some of the lands which were already under the occupation of the landless people. But mainly only *pattas* were given but actual possession of land was not given (Suri and Raghavulu 1996).

Land Settlement and Land Reforms in Orissa:

Orissa was scattered into various provinces, accordingly three board type land tenure system: the *Zamindari* system in five districts, the *Ryotwari* system in a part of district and the secondary alliances in a number of princely states covering as many as seven districts of Orissa. In the main land of Orissa the Zamindari settlement was enforced and a very high rate of revenue was collected. When the average assessment per sq.km in Bihar and west Bengal was Rs. 171 it was Rs.232 in case of Orissa. Besides initially under frequent temporary settlement the revenue assessment were repeatedly enhanced. As a consequence the local Zamindars borrowed from the outside shroffs at an enormous rate of interest and with in a short time almost half of them disposed due to their failure to pay the revenue in time. Many estates fell into the hands of Bengali and Muslim speculators. The peasant movements of 1817, 1833 and 1847 were some of the most powerful upswings of the time against the insecurity and the exactions. But the act and the movements remained largely ineffective due to the absence of any sustained peasant struggle (Pathy 1981).

Several princely states remained under the control of British called as subsidiary alliance. In these areas the princes were given absolute freedom of internal administration as long as

they continue to pay tribute to the colonial authority. The terms were rather liberal for the bigger states compared to the smaller units. The bigger states were charged with very little tribute money than the smaller units just to make the bigger powers allies to the British domination. Thus the tributary landlords were under pressure to collect higher rents from the peasantry as they had to keep the patty princelings above going, supporting their henchmen as well as social obligations like the temples (Barik 1989). The feudatory states witness several cases of peasant and tribal discontent. The consistent agitation of people since the 1930s in the feudatory states, popularly known as prajamandal movement" ultimately led to their merger in the state of Orissa in 1948-49 (Bailey 1959).

The *Ryotwari* settlement was of minor importance in Orissa as it covered a part of a district. This system too in course of time created a class of renters from among those was employed for the collection of revenue and to look after the problem of law and order. The small peasants became indebted and sold their small parcels of land. The Madras Estate Land Act could not be enforced. Since 1934 a coordinated movement continued under the leadership of the communists the Kisan Sabhas (Pathy 1981).

The system of land in Orissa under British rule was directed to protect and encouraging the interest of Zamindars and the princes. At the time of independence the land structure was dominates by big feudal and semi-feudal interest. At the time of independence there was 81 percentage of privately owned land under Zamindary system (Pathy 1981). Although a fifth of the total cropped land was irrigated and a tenth of the land was under cash crop cultivation, the type of land control could not allow capitalistic development of agriculture.

The Orissa government instituted limited land reforms envisaging abolition of intermediary tenures that prevailed between the state and the tillers of the soil, tenancy reform and fixation of ceilings on agricultural holdings. The Orissa Estate Abolition Act 1951 intended to eliminate the intermediary interests. There were altogether 4, 25,693 estates out of which by 4, 21,022 were abolished by 1972. The big landowners were asked to surrender all land except personally cultivated land up to 33 standard acres. In addition they were permitted homestead land up to 20 acres, gazing land, temple trust and propose factory site. In fact the

landlords were allowed legally hundreds of acres of land. In lieu of abolition of their rights they were paid a higher rate of compensation then many other states of India.

The second major reform was tenancy reform, passed as Orissa Tenants Protection Act in 1948. The act restricted eviction of tenants by any landlords owning more than 33 acres and the maximum rent was limited to one third of the gross produce in case of tenants having occupancy rights, two-fifth for tenants without any security of tenure. Only in coastal districts where the landlords generally did not exceed the ceiling enacted, it was applied retrospectively. As a result large scale arbitrary eviction took place leading to widespread agitations in the coastal belt. In this state Land Reforms legislation affected only 0.15% of land as a result of tenancy reform (Deininger, Jin and Nagarajan 2007).

Orissa Reform Act 1960 was introduced to consolidate the rights and benefits accruing under various legislative and executive measures preceding it. This act amended by the Orissa Land Reform Act 1965, which provided fixation of fair rent at one fourth of the gross produce. It permitted rights of ownership of holdings to the tenants in respect of non resumable lands on payment of compensation equal to 10 times of fair rent. Further the Orissa Land Reform Act (1974), for the first time extended tenancy rights to sharecroppers, temporary leases and recorded and unrecorded sub-tenants. Some special provision also provided to SC and ST members. But the act holds that a tenant can be evicted if the uses the land in a manner which render it unfit for cultivation (Pathy 1975). The land Reform Act 1974 fixed a ceiling between 10 to 45 acres of various classes many type of lands were exempted from ceiling land such as plantation orchards, land for religious and educational institutes, factory sites etc. The act provided a payment of 50 percent of the market prices of the permanents structure like tanks, wells etc in surplus land. But the landlords have not come forward, the government has only estimated the surplus of 1.71 lakh acres i.e. less than half percent of cultivated area. According to Deininger, Jin and Nagarajan_(2007), only 2.24% of land was affected as a result of the ceiling legislation.

The land reform in Orissa was not able to transfer the semi-feudal agrarian structure. It was too timid to bring out radical change in rural Orissa. They operated within the legislative

context of the system which has pledged solemn respect to the individual property rights. Though the legal and extra legal means the ceiling restriction were by passed and semi feudal landlords have managed to retain large chunks of land. Less than one percent of the cropped land is declared surplus which again is yet to be acquired for redistribution. Similarly the tenancy laws were almost made infracted, eviction continued and legal rental shares are openly violated. It estimated that a meager of 0.6 percent of the state's total farm land- 45,406 hectare out of total 76 lakh hectare has been made available so far for distribution among the 86,161 people under the land reform act (Pathy 1975).

If one compares the two states, Andhra Pradesh had a larger proportion of land under *Ryotwari* system wherein the owner was also the cultivator, when compared to Orissa. So Andhra Pradesh has a larger proportion of households who respond to signals and also appropriate to the returns. The land reforms system was also more successful in Andhra Pradesh when compared to Orissa to change the distortions generated by the land settlement process.

2.2.2. *Alternative forms of Organization of Production:*

There could exist alternative systems of organization of production in agriculture. One of the systems of organization of production is the tribal[4] system of organization of production and the second is the peasant based organization of production. A tribal method of organization of production is a user right based system of organization of production with extensive dependence of 'nature' or forests for the survival of the economy. In a tribal system the allocation and re-allocation of resources are user right based with low level of interactions with the outside world. In this type of economy, the individuals are dependent on the forests for food and survival. Given the user right based system of organization of production in a tribal economy with low interaction with the outside world, the necessary condition for modern form to exist i.e., individual private property rights on resources is absent. This constrains the economy from expanding the production for the agent.

[4] According to the Macmilan Dictionary of Anthropology, Tribes are defined as a descent and kinship based group in which subgroups are clearly linked to one another with the potential of uniting a large number of local groups for common defense or welfare. Tribes are generally settled farmers and depend on the livestock.

The share of tribal population to the total population in Andhra Pradesh was only 3.68% in 1961 census. The percentage share of tribes increased to 6.60% in 2001 census. This shows that the share of tribal population in the state was less than 10% in 2001 census. In the 1981 census, there was significant increase in the share of Scheduled Tribe (ST) population compared to any other period. In the state of Orissa, the tribals constitutes nearly 24% of the total population in 1961 census. Thus in 1961 census one fourth of the state's population had low interaction with the market condition. The share of ST population in Orissa remained stagnant throughout the period and in 2001 census the share of ST population was 23.95%.

This indicates that the share of ST population was comparatively higher in Orissa than in Andhra Pradesh. In the 2001 census, the share of ST population was four times higher in Orissa than in Andhra Pradesh.

Table: 2.1 Percentage of ST Population in Two States: A Decade Wise Analysis:

Census	Share of ST Population	
	Andhra Pradesh	Orissa
1961	3.68	24.08
1971	3.81	23.11
1981	5.93	23.43
1991	6.31	23.86
2001	6.60	23.95

Source: Statistical Abstract of Andhra Pradesh and Orissa.

The districts wise analysis shows that in Orissa, among the 13 districts, there were 7 districts in which the tribal population was more then 50% of the total population in 1961 census. In 1961 census, the share of ST population was highest in the districts of Mayruabhanj (60.61%), Koraput (60.89%) and Phulbani (44.59%). In the 2001 census in Orissa, among total 30 districts, 14 districts witnessed ST population more then 30% (in those districts the share of ST population ranged from 31% in Jharsuguda to 57% in Malkangiri) out of the total population (See Appendix: 2). There are total 62 tribes in Orissa and they mainly inhabit in the eastern gaths hill range.

On the contrary, in the case of Andhra Pradesh, there was not even one district in which the tribal population was more then 20% of the population. In Andhra Pradesh, Khamam district had the highest proportion of tribal population which was around 15% in 1961 census. In the

2001 census in Andhra Pradesh, out of total 23 districts only 5 districts witnessed share of ST population more than 10% of the total population. The share of ST population was highest in Khammam district (26.47%) in 2001 census (Appendix: 1).

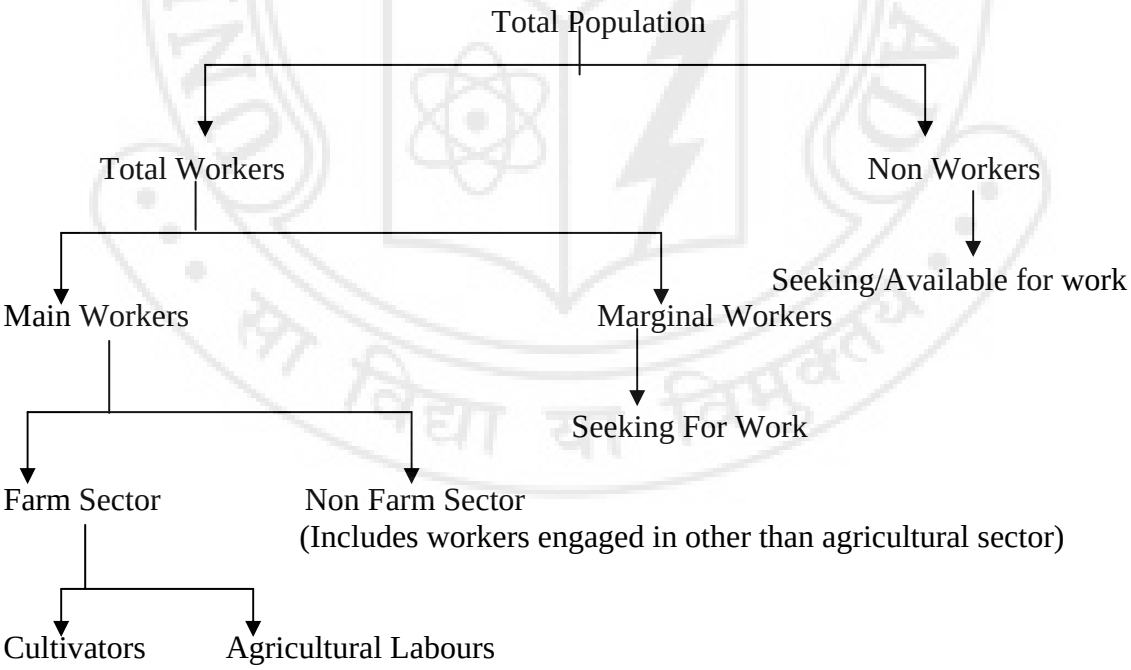
The tribal population is much higher in the state of Orissa when compared to Andhra Pradesh. In addition, the importance of natural economy declined over time in the state of Andhra Pradesh with the tribal population getting more and more integrated with the peasant economy. This could be a result of the state policies which have actively intervened into the natural economy and created a market for the goods from this economy and sold then outside [Girijan Co-operative societies (GCC)] or intervention by peasant migrants and the state produced market oriented crops like to tobacco, cashew, etc. But this decline is not witnessed in the state of Orissa. Even in the present period there are large extent of areas in Orissa which do not have roads or communications and accessing them is difficult.

2.2.3 *Labor Force Distribution:*

The allocation of labor is captured in terms of the labor force distribution as main workers and marginal workers in the economy. The factor under an individual as a main or marginal worker depends on two major issues. The labor force distribution gives the 'potential' supply side of the labor market i.e., individuals who can supply labor in the market. But an individual may voluntarily opt to be a non-worker, main worker or a marginal worker. This could again be for two reasons. One is that, at the existing wage rate, the household prefers not to enter the labor force. Secondly, there are some individuals who are below the working age or crossed the age in which they can be active workers. So the demographic profile is important to capture 'active' work force in the economy. The third major issue influencing the decision of households to be classified into these groups is the existence of demand for their labor. A low demand with downwardly rigid wages can also shift individuals from one group to another. These are pertinent issues in the study of labor force distribution. But this study concentrates on implication of the existing labor force distribution. A state with a large proportion of non-workers might have to spend more resources on consumption rather than on investment.

"When a person had participated in work in a major part i.e. six months (or 183 days) or more of the preceding one year before the date of enumeration, that person is considered as a main worker" (Census of India 2001, Page no. 19). "When a person participated in work and the period of work less than six months (or 183 days), she/he considered as marginal workers" (Census of India 2001, Page no. 19). "All those who do not qualify as main workers or marginal workers are classified as non workers in census" (Census of India 2001, Page no. 19). The definitions given by census for all categories have undergone many changes. In 1981 and 1991 Census, the definition for workers and non workers remained the same, including collection of information on "seeking or available" for work from non workers to net the number of entrants to the labour force. In 2001 census, this information was collected not only from non workers but from marginal workers too. The details regarding all the category of workers is presented below. The classification of population according to main and marginal workers was not provided for the 1961 census.

The following diagram is a portray representation of the classification of workers.



Total worker as a share of total population in Andhra Pradesh was 51.86% in 1961 census in contrast to 48.13% of non workers. The share of total workers declined sharply in the 1971 census to 41.40%. In the 1981, 1991 and 2001 census the share of total workers to the total

population remained stagnant with around 45%. In Orissa, the share of total workers to the total population was 43.65% in 1961 census, but there was sharp decline in the proportion of total workers in 1971 census to 31.21%. After the 1971 census, the share of workforce increased to 38% in 1981 census and remained stagnant till 2001 census. The proportion of workers is consistently greater in all the years for Andhra Pradesh when compared to Orissa.

Total workers are divided into main and marginal workers according to their working time. For the state of Andhra Pradesh the share of population engaged as main workers were 38.50% in 1971 census and the share increased in the 1981 census to 42.26%. In 1981 and 1991 census the proportion of main workers as a percentage of total population remained stagnant. In the 2001 census, there was sharp decline in the share of population engaged as main workers. The share of population worked as main workers in Orissa was comparatively lower than that in Andhra Pradesh. In 1971 census, only 26% of population worked as main workers as a share of total population in Orissa, but the share increased marginally till 1991 census. There was decline in the percentage of main workers in 2001 census. Both the states witnessed the similar trend of the share of workers engaged as main workers but the share was significantly higher in Andhra Pradesh than in Orissa in all the time period.

Table: 2.2 Share of Total Workers and Non Workers in Two States (From 1961 to 2001 Census):

Workers/Census	1961	1971	1981	1991	2001
Andhra Pradesh					
1 Total workers	51.86	41.40	45.76	45.05	45.78
1.1 Main workers	NA	38.50	42.26	42.76	38.10
1.2 Marginal workers	NA	2.89	3.50	2.29	7.68
2 Non workers	48.13	58.59	54.24	54.95	54.21
ORISSA					
1 Total workers	43.65	31.21	38.01	37.53	38.78
1.1 Main workers	NA	26.53	32.74	32.77	26.05
1.2 Marginal workers	NA	4.68	5.25	4.75	12.74
2 Non workers	56.34	68.76	61.99	62.47	61.21

Note: All the categories of workers are presented as a share of the total population.
Sources: Statistical Abstract of Andhra Pradesh and Orissa.

The share of marginal workers as share of the total population remained around 3 percentage till 1991 census in Andhra Pradesh. There was significant increase in the share of the

marginal workers to 7.68 percent in the 2001 census. The proportion of marginal workers was consistently higher in the state of Orissa when compared to that in Andhra Pradesh.

The above analysis of economic classification of workers shows that in Orissa the share of non-workers was higher than the share in Andhra Pradesh. This shows that the number of population dependents on the 'productive' workers is consistently higher in the case of Orissa when compared to Andhra Pradesh. A higher share of dependent population in the economy implies that the share of surplus that could be invested would decline in this economy and has to be assigned to meet the consumption of the individuals in the economy. In a longer time period of analysis, the surplus invested would decline thus performance of the agents and by implication the economy would be affected.

Section: III *Demand Side Constraints Introduced by Structure on the Performance of Agents:*

A demand side constraint introduced by the structure on the agents is one where individuals do not want to expand their production due to lack of demand in the system. The lack of demand for the goods produced by the agrarian sector can be generated due to distribution of land holding in the economy. An increasing importance of marginal and small farmers, who produced foodgrains and do not specialize in agricultural production may constraint the demand for the goods produced by the agrarian structure. The second demand side constraint is the allocation of labor between different occupations. An increasing share of workforce in industry and or service sector can generate a larger demand for goods produced by the agricultural sector as well as labor in agricultural sector. This generates a demand for goods produced by the sector necessitating a re-allocation in the agricultural sector. The present study analyses the composition of aggregate land holding and the composition of labor force distribution to infer on the 'potential' demand for the agricultural goods.

2.3.1 *Land Holding Pattern:*

Two of the observed regularity in the changes in the land distribution over time is the increasing share of smaller holding and also an increase in the proportion of land held by these households. One of the important explanation for these observed regularity is the hereditary partitioning of land in these households (Vyas, 2003)**.** An increase in the proportion of small and marginal holdings can constrain the demand for goods that are produced even in the agricultural sector. These households might produce goods for their own self consumption and in the process, may not initiate a process of specialization in the economy.

The land holding pattern explains the production structure or the production organization of the states over the period of time. The operational holding structure of the land is divided into categories like marginal, small, semi-medium, medium and large group according to the land distribution. The data regarding the land holding pattern is available in every five year interval starting from 1971 and collected from the statistical abstract of respective states.

Size Distribution of Ownership Households:

The percentage of household holdings in each group is presented in the table 2.3. There has been continuous increase in the marginal land holder households in Andhra Pradesh over the period. Percentage of house holders owning small land holding witnessed an insignificant increase over time in Andhra Pradesh. The share of households owning small land holding was 18.54% in 1970-71, it increased to 21.84% in 2000-01. This shows that in the state, the share of households owning marginal and small holdings has witnessed increase in the trend over the period. There is a decline in the semi-medium land holding household from 1970 (17.38%) to 2000-01 (12.34%) in Andhra Pradesh. The households operating medium and large holdings declined significantly over the period in Andhra Pradesh. Total households owning together marginal and small land holdings in Andhra Pradesh was 64.51% in 1970-71, it increased to 80.75% in 2000-01. On the other hand, medium and large holdings were owned by only 17% of households in 1970-71 and it declined substantially to 6% in 2000-01. This shows that there was sharp decline in the households owning semi-medium, medium and large holdings and increase in the households owning marginal and small

holdings in Andhra Pradesh. The figure 2.1 represents the land distribution pattern in Andhra Pradesh.

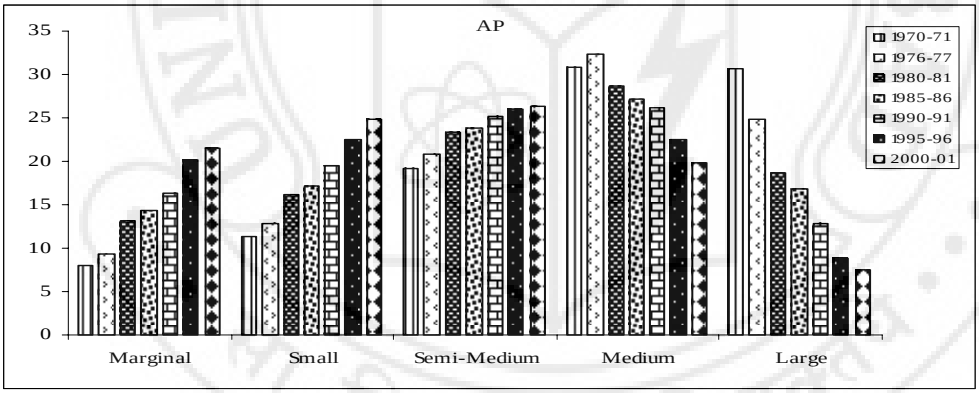
Table: 2.3 Percentage of Households in Each Group of Land Holding (1970-71 till 2000-01):

Years	Marginal		Small		Semi-Medium		Medium		Large	
	AP	ORI	AP	ORI	AP	ORI	AP	ORI	AP	ORI
Growth Rate	*5.21*	*4.37*	*2.14*	*-2.36*	*-6.04*	*-2.52*	*-18.41*	*-14.87*	*-34.04*	*-25.85*
1970-71	45.97	43.29	18.54	32.87	17.38	13.27	12.71	9.07	4.32	1.44
1976-77	46.60	46.66	20.34	29.05	17.44	16.77	12.24	6.49	3.40	1.00
1980-81	49.26	46.84	20.93	26.77	16.05	18.33	9.06	7.15	2.12	0.84
1985-86	54.20	52.09	20.82	25.38	15.24	16.26	7.98	5.69	1.77	0.59
1990-91	56.09	53.65	21.23	26.22	14.48	15.05	6.93	4.96	1.27	0.38
1995-96	59.42	54.08	21.33	27.89	13.16	13.72	5.31	3.93	0.78	0.38
2000-01	60.90	56.41	21.84	27.37	12.34	12.29	4.35	3.57	0.57	0.32

Note: Marginal – below 1.00hect. Small- 1.00 to 2.00 hectares. Semi-medium- 2.00 to 4.00 hectares. Medium -- 4.00 to 10.00 hectares. Large- 10.0 and above.

Source: Statistical Abstract of Andhra Pradesh and Orissa.

Figure: 2.1 Percentage of Households in Each Group of Land Holding in Andhra Pradesh (1970-71 till 2000-01):

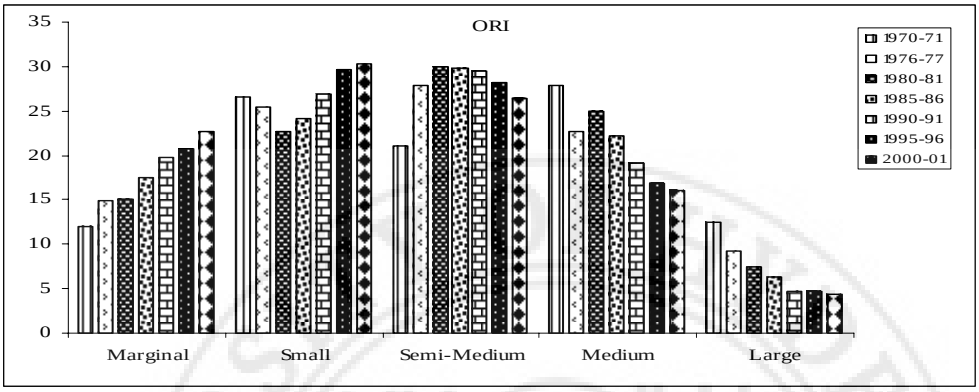


Sources: Statistical Abstract of Andhra Pradesh.

In Orissa the share of households operating marginal lands increased over the period of time on the other hands the households owning small land holding declined (Figure: 2.2). Share of marginal household was 43.29% in 1970-71; it rose to 56.41% in 2000-01. The share of small households was 32.87% in 1970-71 and it declined to 27.37% in 2000-01. Semi medium households witnessed hardly any change over the period in Orissa. The households owning together marginal and small land holdings were 76.20% in 1970-71, it increased to

81.97% in 2000-01 whereas total 10% households were owning together medium and large land holdings in 1970-71 and it decline to 4% in 2000-01 (table:2.3).

Figure: 2.2 Percentage of Households in Each Group of Land Holding in Orissa (1970-71 till 2000-01):



Sources: Statistical Abstract of Orissa.

The comparison of land holding pattern in two states illustrates that in Andhra Pradesh there was a drastic change in the households owning land among large and medium holdings. The rate of change in the marginal and small holding was 28% and the rate of change in the medium and large holding was -71%. But there was not significant change in the land holding structure in Orissa. The rate of increase in the land holding under marginal and small was just 10% and the there was only -60% decline in the holdings of medium and large workers in Orissa. The percentage of land holding under marginal and small was significantly higher in Orissa compared to that in Andhra Pradesh at the starting point itself (1970-71). There was substantial increase in the share of marginal and small holders in Andhra Pradesh but in Orissa the share of marginal holdings increased and small holdings declined over the period. It shows from the initial period the dominance of marginal and small holding structure was prominent in Orissa and there was no significant change in the household owning land holding structure in the economy.

Area under Operational Holdings:

The data regarding the area operated under each holding type is presented as a percentage of total operational holding. The area under marginal holding in Andhra Pradesh increased three times from 1970-71(7.99%) to 2000-01(21.56%). Percentage of area under small land

holding also demonstrates an increasing trend in Andhra Pradesh. It was 11.28% of the total holding in 1970-71 and it increased to 24.76% in 2000-01. Andhra Pradesh showed increase in the percentage area under semi-medium holding from 19.19% in 1970-71 to 26.35% in 2000-01. The percentage of area under medium and large land holdings witnessed continuous decline over the period in Orissa. The rate of decline in the area under large holdings was faster than the decline in the area under medium holding in the state.

Table: 2.4 Percentage of Land under Each Group of Holding (1970-71 to 2000-01):

Years	Marginal		Small		Semi-Medium		Medium		Large	
	AP	ORI	A.P	ORI	A.P	ORI	A.P	ORI	A.P	ORI
Growth Rate	*1.69*	*1.00*	*13.13*	*1.21*	*5.25*	*2.46*	*-7.65*	*-7.23*	*-23.23*	*-17.71*
1970-71	7.99	11.94	11.28	26.57	19.19	21.12	30.81	27.82	30.72	12.52
1976-77	9.29	14.83	12.77	25.47	20.81	27.80	32.32	22.67	24.82	9.18
1980-81	13.10	15.05	16.16	22.61	23.31	29.94	28.73	24.94	18.69	7.43
1985-86	14.40	17.47	17.21	24.20	23.78	29.79	27.11	22.18	16.79	6.35
1990-91	16.38	19.73	19.55	26.93	25.17	29.48	26.12	19.11	12.78	4.76
1995-96	20.20	20.68	22.46	29.59	25.99	28.21	22.48	16.80	8.86	4.72
2000-01	21.56	22.76	24.76	30.37	26.35	26.45	19.83	16.08	7.50	4.33

Note: Marginal – below 1.00hect. Small- 1.00 to 2.00 hectares. Semi-medium- 2.00 to 4.00 hectares. Medium -- 4.00 to 10.00 hectares. Large- 10.0 and above.

Source: Statistical Abstract of Andhra Pradesh and Orissa.

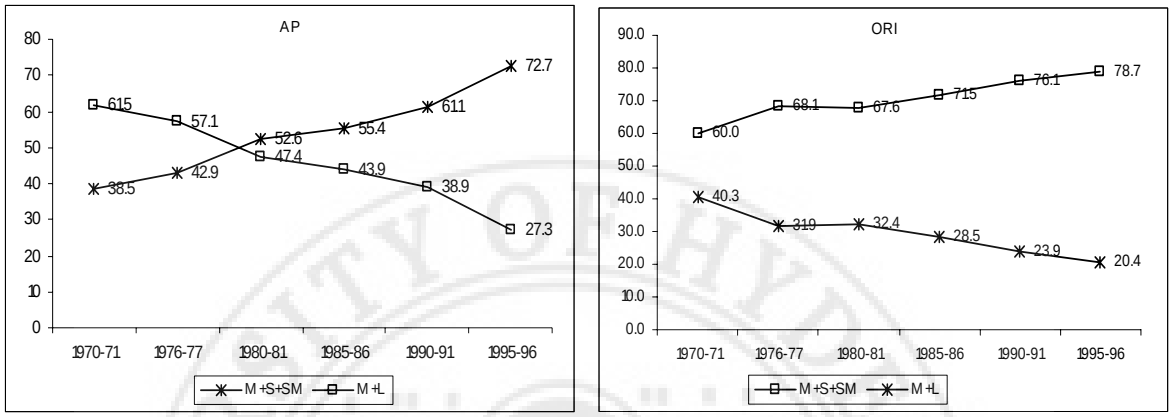
In Orissa the share of area under marginal and small land holdings has increased over the period. The percentage of area under marginal holding in Orissa witnessed increasing trend (from 11.94% in 1970-71 to 22.76% in 2000-01). The share of area under small land holdings was higher compared to the marginal holdings in Orissa. In the state, there was no major change in the area under small holdings (the share was 26.57% in 1970-71, increased to 30.30% in 2000-01). The area under medium and large land holdings was relatively lower compared to the marginal and small holdings. Both the share under medium and large holdings declined from 40% in 1970-71 to 20% in 2000-01 (Table: 2.4).

The share of area under medium and large holdings in Orissa was significantly lower than that in Andhra Pradesh in all the period as well as in the initial period. There was only 12% (the share declined to 4.33% in 2000-01) of land under large land holdings in Orissa in 1970-71 and 30.72% (the share declined to 7.50% in 2000-01) of land was under large land holdings in Andhra Pradesh. Both the states witnessed a decline in the trend of percentage

area under medium and large holdings. But the rate of decline in Andhra Pradesh was significantly higher than the decline in case of Orissa.

Figure: 2.3 Percentage of Area under Different Holdings in Two States (1970-2000):

(a) (b)



Sources: Statistical Abstract of Andhra Pradesh and Orissa

The graphical representation of the comparison of the change in area under land holdings in two sates is presented in figure: 2.3. The above analysis shows that there was increase in the area under marginal land holdings in both states. The area under small holdings hardly witnessed any change in Orissa, but it increased significantly in case of Andhra Pradesh. Percentage of area under semi-medium holdings witnessed opposite trend for both the states. There was increase in the area under semi-medium group in Andhra Pradesh but marginal decline in share for Orissa. The major difference between the two states surfaced with regards to the land holding structure at the initial period (1970-71) when there was total 38% land under marginal, small and semi-medium holdings and 62% of land under medium and large holdings in Andhra Pradesh. But in Orissa at the same period there was 60% of land under marginal, small and semi-medium group and only 40% was under medium and large holdings. This shows in the initial period the land holding structure was just opposite in two states. Over the period in Andhra Pradesh the share of land under marginal and small holdings has increased from 38% in 1970-71 to 72% in 2000-01, where as the land under medium and large holdings has declined from 62% in 1970-71 to 28% in 2000-01. On the other hand in Orissa, the share of land under marginal and small holdings was 60% in 1970-71 and it raised to 79% in 2000-01. The share of land under medium and large holding was

40% and it declined to 20% in 2000-01. This shows that when compared to Orissa, the land holding structure has changed significantly in Andhra Pradesh.

2.3.2 *Workers Engaged in Different Sectors*:

One of the important generalizations in economics is that development involves the changes in the composition of national output. The share of primary sector (and agriculture) declined in the national output with an increase in the share of secondary (and industry) and later in an increase in the share of tertiary sector. And yet, a puzzling feature is that the allocation of labor of the economy to various activities has only witnessed marginal changes. Agriculture continues to hold on to a large number of labours in the economy. In the process of development, one would have expected the change in the composition of labor as well as output. In the process of industrialization and modernization one would have expected labor to migrate out of agriculture necessitating a re-allocation in the system. In the process, one will also witness an increased demand for foodgrains as well as demand by agro-based industry if any agro-based industry exists. This sub-section presents the aggregate allocation of labor in the two states.

The workers engaged in different sector are presented in the table: 2.5 and 2.6 for both the states. Cultivator and agricultural labours are called as ‘farm sector workers’ whereas the rest of all those who are not engaged in agriculture are called as ‘non-farm sector workers’. In the 1961 census, the share of population engaged in farm sector (including both cultivator and agricultural labours) was significantly higher than the non farm sector. The total workers in the farm sector were 66.70% and the rest 31.30% of workers were engaged in the non-agricultural activity. Among the non farm sector, share of workers engaged in household industry and trade and commerce was high. In the 1971 census, the share of cultivators had declined where as the share of agricultural labours had increased. Thus the total workers engaged in the farm sector increased marginally to 70%. Total workers engaged in the non-farm sector were 22.90%. This shows that the share of non farm sector workers declined in 1971 census compared to 1961 census. The workers engaged in the manufacturing industry increased where as workers engaged in household industry declined

in the 1971 census compared to the 1961 census. The data regarding the workers engaged in all sectors in 1981 was not provided in the census. In the 1981 census the share of cultivators and agricultural labours declined[5]. This shows the share of farm sector workers in Andhra Pradesh was 64% and the non farm sector was 28.14%. In the 1991 census, both the share of farm sector and non farm sector increased with a decline in the share of marginal sector in the state. Among the non farm sector workers, the share of workers engaged in manufacturing (5.19%) trade and commerce (6.35%) increased. There was decline in the farm sector workers from 65% in 1991 census to 49% in 2001 census (But the share only includes the Workers under Main workers). The increase in the share of the marginal sector workers to 16.77% compared to the 5.07% in 1991 includes both farm and non farm sector workers. The decline in the share of farm sector workers led to the increase in the non farm sector as well as marginal workers in the states. This indicates that in Andhra Pradesh there was a decline in the farm sector workers and increase in the non farm and marginal workers over the periods.

Table: 2.5 Percentage of Workers Engaged in Different Sectors in Andhra Pradesh (1961 census to 2001 census):

Workers/Census	**1961**	**1971**	**1981**	**1991**	**2001**
Farm Sector	**68.70**	**70.12**	**64.20**	**65.14**	**49.26**
Cultivator	40.11	32.20	30.23	26.34	21.11
Agricultural Labour	28.59	37.92	33.97	38.80	28.15
Non Farm Sectors	**31.30**	**22.88**	**28.14**	**29.79**	**33.88**
Household industry	9.73	4.72	4.34	3.19	3.88
Manufacturing	2.55	4.22	NA	5.19	NA
Livestock Forestry Fishing	3.01	3.28	NA	2.50	NA
Trade Commerce	4.27	5.45	NA	6.35	NA
Construction	1.18	1.59	NA	1.57	NA
Transport, Storage and Communication	1.28	2.10	NA	2.65	NA
Others	9.28	1.54	23.80	8.34	30.00
Marginal workers#	**NA**	**7.00**	**7.66**	**5.07**	**16.77**

Note: The workers in different sector are presented as a share of total workers in the state.
The data regarding workers engaged in all sectors is not provided for 1981 and 2001 census.
Marginal worker is a worker who participated in work and the period of work less than six months. Marginal workers include both "Farm sector" and "Non farm sector" workers.

Source: Statistical Abstract of Andhra Pradesh

[5] In the 1981 census other workers includes all the workers engaged in the non farm sectors

In 1961 census, the share of cultivators and agricultural labours in Orissa was higher than the other workers. In Orissa, total 74% of the population was engaged in the farm sector and only 26% of population worked in outside of agricultural sector in 1961 census. The percentage share of workers engaged in the farm sector witnessed marginal decline to 69% in 1971 census and the total workers engaged in outside agricultural sector was 21%. Thus there was not diversification of workers from farm to non-farm sector but the decline in the share of the farm workers shifted towards marginal workers in Orissa. The share of farm sector workers was 64% and 63% in 1981 and 1991 census respectively. The share of non farm sector workers also did not show any significant increase in 1981 and 1991 census. In the 2001 census the share of cultivators and agricultural labours who work as main workers witnessed sharp decline compared to the 1991 census. The total farm sector workers were 38% (includes only main workers) and the workers engaged outside agriculture were 28%. This shows that with the decline in the share of workers engaged in the agricultural sector there was no significant increase in the workers in the non agricultural sector in the state, rather the proportion of the marginal workers has increased tremendously over the period (The marginal workers includes both farm and non farm sector workers who works for less than 6 months). .

Table: 2.6 Percentage of Workers Engaged in Different Sectors in Orissa (1961 census to 2001 census):

CENSUS	**1961**	**1971**	**1981**	**1991**	**2001**
Farm Sector	**73.83**	**69.52**	**64.36**	**63.75**	**38.76**
Cultivator	56.82	46.20	40.44	38.70	24.06
Agricultural Labour	17.01	23.32	23.92	25.05	14.70
Non Farm Sector	**26.17**	**21.43**	**21.80**	**23.57**	**28.41**
Household industry	6.94	3.60	2.84	2.73	2.83
Manufacturing	1.13	2.19	NA	3.06	NA
Livestock Forestry Fishing	1.71	2.72	NA	2.47	NA
Trade Commerce	1.92	3.31	NA	4.69	NA
Construction	0.39	0.58	NA	0.75	NA
Transport Storage Communication	0.65	1.46	NA	1.53	NA
Others	13.39	8.47	18.96	8.34	25.58
Marginal workers	**NA**	**9.05**	**13.84**	**12.68**	**32.83**

Note: The workers in different sector are presented as a share of total workers in the state.
The data regarding workers engaged in all sectors is not provided for 1981 and 2001 census.
Marginal worker is a worker who participated in work and the period of work less than six months. Marginal workers include both “Farm sector” and “Non farm sector” workers.

Source: Statistical Abstract of Orissa.

The analysis of the work force engaged in different sectors in two states shows that the share of farm sector workers as well as the non-farm sector workers was higher in Andhra Pradesh compared to Orissa, over the time period. On the other hand the share of workers engaged in the marginal sector was significantly higher in Orissa than that in Andhra Pradesh.

Section: IV ***Variability in the Natural Condition: Rainfall***

Indian agriculture is always termed as a gamble in the hand of monsoon, where the rainfall leads to instability even after green revolution (Rao, Ray and Subbarao 1988). Natural factor that affect agricultural production are weather, temperature, drought and climate change and rainfall. Weather is a narrow factor that affects the crop production (Ramaswami, Ravi and Chopra 2003)[6]. According to them weather include sunlight, which shows a little variation from year to year, so not regarded as a major factor of crop production or variability. Temperature is also another factor of weather, but the variation in temperature is not significant from year to year. Here rainfall is used as a proxy for the natural conditions. According to the National Commission of Agriculture, rainfall fluctuation could be responsible for 50% of variability in yields. Variability in the monsoon is a significant factor in governing farming practice and variability in yields. The intensity and degree of monsoon rainfall vary from year to year[7].

The rainfall data for Orissa and Andhra Pradesh is collected from Statistical Abstract of Respective States. The rainfall data in Orissa is available in terms of actual and normal rainfall for the year. This study considered the actual rainfall of the state for every year. The data for Andhra Pradesh rainfall is available in terms of monsoon and post monsoon rainfall

[6] Ramaswami Bharat, Shamika Ravi and S.D. chorpa (2003). Risk Management in Agriculture. Discussion Paper. Indian Statistical Institute, Delhi.

[7] The report of national commission shows that the coefficient of variation of monthly rainfall is high in most part of country and in most time of year. The coefficient of variation of monthly rainfall in the rainiest months and areas is as high as 40% to 50% over most central, north and eastern states. In south the coefficient of variation is 60 to 100%. In general variability of rainfall over short period horizons is much greater than over the long horizons. Ramaswami, Ravi and Chopra (2003), found out the elasticity or one percent deviation in production from its trend due to one percent deviation in rainfall from its normal level. They found that states Assam, Karnataka, Madhya Pradesh, Maharashtra, Orissa, and Tamil Nadu have experienced a significant rise in the sensitivity of food grains output to variation in rainfall. States which have experienced a significant decline in the sensitivity of their food grain output to variations in rainfall are Bihar, Haryana, Himachal Pradesh, Kerala, Punjab and Andhra Pradesh.

for each year. The rainfall received in monsoon and post monsoon period is added together to find out the total rainfall received in a year in Andhra Pradesh. The amount of rain received in different time period in both the state is presented in the table 2.7.

Table: 2.7 Amount of Rainfall in Two States in Each Decade (1960 to 2005):

(in M.M)

Years	AP	ORISSA
1960-61	850	1535
1970-71	956	1660
1980-81	884	1321
1990-91	982	1865
2000-01	890	1022
2005-06	936	1658

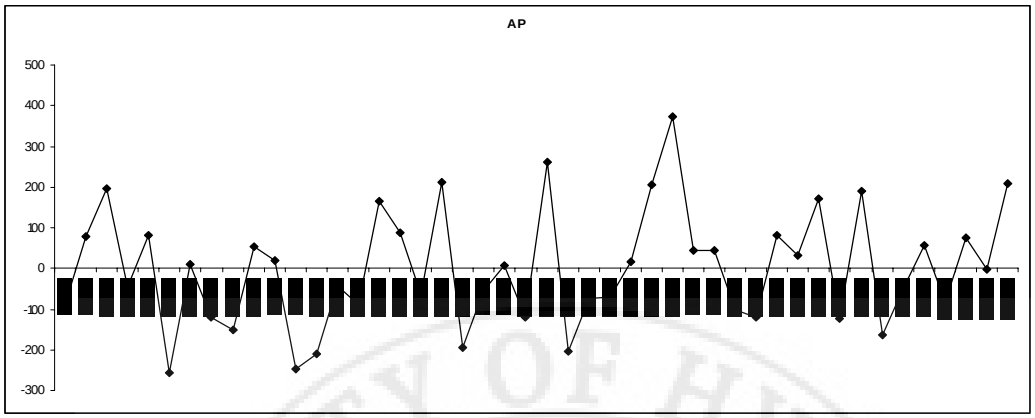
Note: The rainfall level in AP is the addition of the monsoon and post monsoon rainfall.
Rainfall in Orissa implies the actual rainfall for the whole year.

Source: Statistical Abstract of Andhra Pradesh and Orissa.

The average rainfall received by the state in the 46years was 937.78mm. Andhra Pradesh receives its rainfall from south-west and as well as North –West monsoon. The south-west monsoon generally starts from early June and continues till end of September. The north-west monsoon occurs from October to December[8]. The variation of rainfall in Andhra Pradesh is shown in the figure: 2.4. The variation of rainfall for each year is defined, as the difference between the rainfall for that year and the long run average. The graph shows that in Andhra Pradesh out of 46 years (from 1960-61 to 2005-06), 12 years shows significantly low rainfall from long run average and 14 years shows significant higher rain above average rainfall.

[8] The average annual rainfall varies from about 74 cm in south to about 200 cm in north with considerable fluctuation. Rayalaseema region is the one with precious rainfall annual average with 69 cm. the maximum rainfall received in this area is in month of august, September, October. There is variation of rainfall receive in Telengana region. The costal areas receive highest average rainfall of about 102 cm (Andhra Pradesh at 50s, a data bese analysis).

Figure: 2.4 Deviation of Rainfall from Long Run Average in Andhra Pradesh (1960-61 to 2005-06):



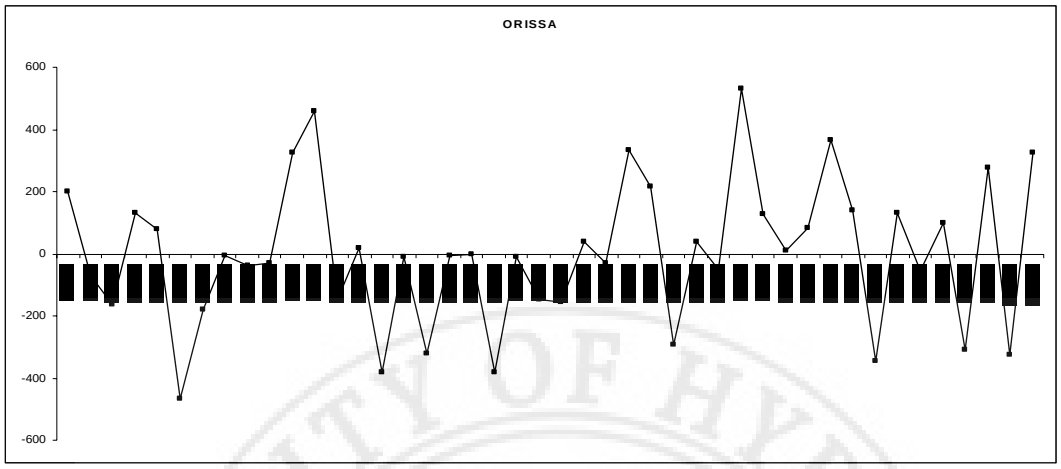
Note: The variation of rainfall calculated by subtracting the amount of rainfall received in each year from the long run average of rainfall.

Source: Statistical Abstract of Andhra Pradesh.

The average rainfall received in Orissa from 1960-61 to 2005-06 is 1333.75 mm. The quantum of rainfall in Orissa not only varies from year to year but also there was wide dispersion in rainfall within the year. Around 80% of rainfall is received with in four months of the year i.e. June to September (Orissa Development Report 2004). This state influenced by the monsoon climate characterized by high temperature from March to May and high rainfall from June to September. Major source of rainfall is from the south-west monsoon and 76% of rainfall is received from June to September. The rainfall in the state concentrate during the relative shot monsoon season leaving a substantial period in the year during which water requirement of the crop exceeds rainfall and on the other hand at both end of monsoon there are periods of highly variable precipitation. The deviation of rainfall in to the long run average in Orissa is presented in graph: 2.5.

The graph shows out of 46 years (from 1960-61 to 2005-06), 15 years shows rainfall as below average and total 16 years shows rainfall above long run average. Being a costal state Orissa suffers from cyclones and flood. Almost in each alternative year Orissa suffers from natural calamities like drought, flood and cyclone. From total 46 years 30 years are abnormal years having occurrence of natural calamities like drought, flood and cyclone with varying intensity.

Figure: 2.5 Deviation of Rainfall from Long Run Average in Orissa (1960-61 to 2005-06):



Note: The variation of rainfall calculated by subtracting the amount of rainfall received in each year from the long run average of rainfall.
Source: Statistical Abstract of Orissa

Orissa receives more amount of rain than Andhra Pradesh. The number of abnormal years i.e. rainfall received above or below average, years in Orissa in the whole period is more than Andhra Pradesh. The graphs also shows that there is wide variation of rainfall in Orissa in recent years compare to Andhra Pradesh, implying the fact that the irregularity of rainfall has raised more in case of Orissa compare to Andhra Pradesh.

Section: V ***Conclusion:***

The two states, Andhra Pradesh and Orissa, get formed at different points of time and are formed by joining areas from diverse administrative and revenue zones. The structure of the two economies is different. The structure of Andhra Pradesh economy seems to provide better 'incentive' for the agent to supply as well as a higher demand from the non-agricultural sector, when compared to Orissa. This is due to the presence of larger proportion of areas with cultivators having property rights on land (Ryotwari areas), a smaller portion of closed-isolated communities (tribal population) and also due to lesser proportion of dependent households in economy. Andhra Pradesh economy has a higher demand for goods produced by the agricultural sector due to the expansion of non-agrarian economy (dominantly Industry) and the nature of land holding pattern in the state. The natural factors, captured in terms of rainfall data, shows that Orissa witnesses a higher

average rainfall when compared to Andhra Pradesh and the variability is also higher for Orissa.

Appendix: 1 <u>District-wise Distribution of Tribal Population in Andhra Pradesh:</u>

Share of Scheduled Tribes to the Total Population in 1961 and 2001 Census in Each Districts	
Districts	2001 census
Anantapur	3.49
Chittoor	3.42
Cuddapah	2.36
East Godavari	3.91
Guntur	4.66
Krishna	2.57
Kurnool	1.97
Nellore	9.08
Srikakulam	5.96
Visakhapatnam	14.55
Vizianagaram	9.55
West Godavari	2.54
Prakasham	3.86
Adilabab	16.74
Hyderabad	0.90
Karimnagar	2.60
Khammam	26.47
Mahabubnagar	7.93
Medak	5.04
Nalgonda	10.55
Nizamabad	7.07
Ranga Reddy	4.09
Warangal	14.10
Total Andhra Pradesh	6.59

Chapter: III

Breaks and Accounting for Breaks in Agricultural Income in Two States

Introduction:

In the post independence period the agricultural performances in India witnessed acceleration in its growth rate of output and income as compared to the pre independence period. The growth rate however, in the post independence period, was not continuous and smooth. The sector witnessed period of acceleration and also period of deceleration in the rate of growth of output and income. This formed the basis for identification of phases (or growth regimes) in the performance of the agricultural sector. The causal factors for different phases, in post independence Indian agriculture, are generally seen to be the outcome of the changes brought by the governmental policies and the role of human agency. However after independence there were efforts to increase the output by increasing the area under cultivation. The growth rate of area under cultivation was 0.4 percent in 1891 to 1947, it increased to 1.2 percent in the period 1950 to 1964 (Rao and Deshpande 1986). After mid sixties, with the introduction of green revolution, the governmental policies aimed at increasing yield by introducing new seed fertilizer technology. The production at that period of time was influenced by the government provision of the inputs and institutional reforms. After 1990s there was privatization of the agriculture sector which made the roads towards the cultivation of the market oriented crops. Thus, the phases of Indian agriculture can be called as area based, yield based and diversification based growth. In this context the present chapter aims at finding the structural break points in agricultural income in Andhra Pradesh and Orissa.

The present chapter deals with three main objectives. The first objective of the chapter aims at measuring the growth pattern of agricultural income in the two states over the period of time. Secondly, the chapter attempts to locate the turning points, as in where the economy has a break in its performance. An attempt has been made here to analyze the growth rate of the agricultural income in different phases of the two states. An attempt is made further to trace out the proximate causes that generate the turning points. Agricultural output or income growth rate depends on the factors like area expansion, yield expansion and change

in cropping pattern. For the analysis, the index numbers of area, yield and crop diversification was calculated instead of the actual data. The crop diversification index is used as the indicator of the change in cropping pattern. The present chapter did not make an attempt to analyse the factors influencing agricultural income growth rate for each phase, the following chapters will deal this issue.

This chapter comprises of seven different sections. The first section discusses the phases in the Indian agriculture. The second section analyses the factors accounting for break point in agricultural income or output. The third section, reviews the past studies that identified different phases in agricultural sector. The fourth section, presents the methodology used for calculation of growth rate and structural breaks in the agricultural income series. In the fifth section, the growth rate of income from agriculture is estimated and also the turning points in the agricultural income series of the two economies are calculated. The sixth section makes an effort to find out the structural break points in area, yield and crop diversification index and examines the contributing factors for the structural break in agricultural income for different phases. The summary and the conclusion comprise the last section.

Section: I Phases in Indian Agriculture:

Performance of the Indian agriculture has not been smooth and continuous in the post independence period. Differences in state policies are generally identified as the sources for the different growth regime. The institutional environments in which the producers are taking decisions are seen not to be conducive to generate sustained high growth, necessitating the intervention by the state. The government policies attempt to change the institutional environment in which the producers are taking decisions. The change in the environment could be in the property right regime or provision of support institutions for the introduction of new technology or reducing the role of the state. One of the major contributors regarding delineating phases has comes from V.M.Rao (2004). His work can be taken as a benchmark in categorizing different periods in the Indian agriculture. He categorized the growth performance of Indian agriculture as area led, yield led and diversification led growth process. Dasgupta (1977) identified the phases in Indian

agriculture as area led growth process till 1964-65 and the green revolution phase after the mid sixties. According to Chadha (2006) Indian agriculture can be looked into two different perspectives: institutional and technological. The institutional approach mainly typified by land reforms and changing agrarian relations, was the strategy adopted in mid-fifties. The technological approach to agricultural development came around the mid-sixties. It made a decisive impact on the agricultural production or productivity, particularly in the regions that had the basic pre-requisites for switching over to new technology.

The first phase in Indian agriculture continued up to mid sixties. During the first half of the 15 year period (from 1949-50 to 1964-65), the increase in the foodgrain production came largely as a result of increase in area (Sen, 1971). The net area sown in all India was 18 percent more in 1980s compare to the net area in the early 1950s (Vaidyanathan, 1993). Most of the area expansion took place in the fifties and sixties but there has been hardly any growth since then. More and more area came under cultivation by reducing fallows, reclamation of cultivable wastes, encroachment of forests, pasture and village common. Thus first phase was a period when extensive farming took place; the limited land reform measures alienated intermediaries between the state and cultivators which ultimately provided an impetus for bringing in more land under cultivation. The growth during this period was primarily due to the expansion of cultivated area. In some parts of the country it permitted a re-definition of property rights and re-structuring of agricultural landholding. This phase was denoted as the 'Area or land-based growth'.

The phase also witnessed the increase in public investment by the state into agriculture. Thus one of the major contributing factors in the first phase was the public investment, in the form of public provision of irrigation, with the change in the institutional arrangements in agriculture like land reforms, provision of credit via formal institutional, marketing regulation etc. Policy measures focused to correct the nature of land rights and the existence of series of intermediaries between the state and cultivators. Interventions to change the institutional structure of Indian agriculture were to a large extent a failure. At the All India level the impact of land reform showed mixed results.

The monsoon failed in two successive years (1966-67 and 1967-68) created a miserable situation in the agricultural sector of India. The major food crisis led to a change in policy towards a technical solution to the problems of agricultural sector without changing the institutional structure. This is generally identified as the "Green Revolution' policy. The green revolution policy depended on public provision of subsidized inputs necessary for production. This marked as the second phase of agriculture policy in the country [Chand, (2001) Deshpande, Bhende, Thippaiah and Vivekanada, (2004)]. The increase in the yield per acre did not come from increase in a sudden spurt but in a gradual stage, particularly after 1960s. After the introduction of the green revolution, apart from irrigation other important factors used in increasing yield per hectare were high yielding seeds and improved cultivation practices like applying manure and fertilizer, intensive weeding and improved pesticide management. All these factors led to intensive cultivation, which became the prime causative factor for growth after mid sixties. After mid sixties the output growth largely depended on the increase in yield per acre (Sen 1971, Mehra 1981 and Vaidyanathan, 1993, Deshpande, Bhende, Thippaiah and Vivekanada 2004). This can also be labeled as the 'yield based growth'. In the yield-based growth period, irrigation played a contradictory role. On the one hand, it can increase the yield and has the capacity to change the economic structure of land holding, with a possible land concentration. However, this case can only happen if the agents operate in a property right regime where flexibility to the markets is possible and to re-allocation of land from inefficient to efficient producers takes place. In such cases, there can be an active land market situation. On the other hand, increased irrigation without such a property regime can truncate the role of the market for land and re-introduce some traditional non-market or personalized exchanges in land.

The changes that occurred in the economy in the post sixties were mainly because of various institutional measures taken up during that period. Two very important institutions are namely Food Corporation of India and Agricultural Prices Commission. After the major famines, in the second phase the government of India gave emphasis in electrification program to provide electricity for agriculture, particularly for ground water irrigation. The use of electric pumps for ground water irrigation was critical for expanding irrigated area which in turn contributed to growth in agricultural productivity and aggregate output (Desai

2002). The policy regimes and the technological changes focused on cereals as a broad group and paddy as well as wheat as the vanguards of the revolution. Latter, new technologies spread to some other crops like cereals, rapeseed and mustard, soybean, sunflower, cotton and sugarcane etc. According to Vyas (2003), the driving force especially from mid 1960s to mid 1980s was technology centered around improved seeds, fertilizer and water management.

Assured irrigation and application of fertilizer led to diversification of crop cultivation from low value to high value crops (Bhalla and Singh 1997). After the early eighties there has been a considerable increase in subsidies and support to agriculture sector while public sector spending in agriculture for infrastructure development started showing decline in real term but investments by farmers kept on moving on a rising trend (Mishra and Chand 1995, Chand 2001). The output growth, which was concentrated in very narrow pockets, became broad- based and got momentum. The rural economy started witnessing process of diversification resulting into fast growth in non foodgrain output like milk, fishery, poultry, vegetables, fruits etc and increased agricultural GDP during the 1980s. In the mid eighties the focus was laid on specific crops or cropping systems. The technology missions for oilseeds, cotton and sustainable development of cereals and sugarcane based cropping systems were some of the important programmes introduced during late eighties. This growth was largely market driven (Chand 2004, Deshpande, Bhende, Thippaiah and Vivekanada 2004). Again after 1991 with the introduction of the WTO, there was a shift from the diversification of cropping patterns towards the commercialized and emphases on the opening of the agricultural market of India in a world wide. In this phase there was government withdrawal from the agricultural field. Thus the third aspect of agricultural growth is a process initiated by the markets by generating a demand for various commercial crops and new crops. We can term this factor as, ‘diversification based growth process’.

Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area in order to expand production related activities in various crops and also to lessen risk. Crop diversification is a concept opposite to crop specialization. It implies shift from single crop farming to multiple crop farming, from subsistence farming to commercial

farming or from low value food crop to high value non food crop. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops (Hazra 2001, Pattanaik and Nayak 2005).

The above discussion of the phases in Indian agriculture identifies broadly three phases. The existence of different phases in Indian agriculture implies, there must be minimum two structural break points in the whole period. The phases are different from one another thus the causal factor for break points should also be different.

Section: II Factors Accounting for Break Points:

While analyzing the agricultural performances, one might notice a turning point, after which the performance accelerates or decelerates and one can expect a turning point in at least one of the growth inducing factors. It is possible that a turning point might coincide with turning points in all the three factors or two or one factor[1]. If the aggregate performance turning point coincides with the land as the factor, one might consider such economy to be traditional economy. In such an economy, traditional institutions continue to play a greater influence on agricultural system hence one can term them as, "nature dependent". The polar opposite case is the turning point in the performance of aggregate agricultural output or income coinciding with the break in crop diversification as the growth process. In this situation one might term the economy as 'modern' to the extent market forces play significant role in re-allocation of resources particularly from land - from low valued self consumption oriented, low risk to a high valued market oriented high risk crops. This indicates a property right regime and information system conducive to market forces. If one considers, yield as a factor, its turning point can give contradictory results. If the property right regime allows for the market re-allocation, the yield factor can accelerate the role of the markets and it can be similar to the diversification factor. Quite on the other hand, if the property regimes are not conducive for market formations, yield as a growth promoter may become synonymous with land as a growth factor.

[1] There could be a possibility wherein factors influencing the performance may not have a turn point but in the process of aggregation over factors the performance of agricultural sector may witness a turn point.

The structural break points for agricultural income or output in one state many not necessarily coincide with the other. There can't be uniform break points for all the states in India as agriculture is a state subject and the policy implemented for the agriculture development depends on the state initiative. The land reform policies was implemented immediately after the post independence period but all the states did not gain similarly from the land reform process as, it depended on the states' structure of the land settlements. Land settlements in states were different due to the prevalence of different landlord based system, thus the implementation of the land reform policy varied across the country. For instance, the land reform came into effect in several eastern Indian states (Utter Pradesh, West Bengal, Orissa, Bihar) with a delay ranging from 4- to 10 years from the independence (Srinastave 1993). The application of modern technology again depends on the resource endowment in each state. For instance the HYV seeds first came into Punjab and Haryana because those states have a large base of irrigated land compared to the eastern India. Thus the structural break in each state may depended on the nature of the state policy.

Section III Literature on Break Points:

There are basically two approaches available for analysing the performance of agriculture over time. The first approach, deals with the public policies and changes there-off. In this they study policies effectiveness in increasing performance of agriculture. For example, the literatures that analysed the trends in agricultural performance based on pre-post green revolution and/or pre-post economic reforms or decadal anlaysis generate one type of study. Basically, these studies attempted to analyse the effectiveness of public policy. The causative process here is from the public role to performance (Subrahmanyam and Sekhar, (2003), Ahluwalia 2000, Dev 1987, Swant, 1997 and Swant and Achuthan, 1995). Thus the first group identified the structural break exogenously from the data. Sometimes, it is problematic to do a clear demarcation of the studies into these exclusive groups (like pre-post green revolution studies, pre-post reform studies and decade wise analysis) but an attempt is made nevertheless to classify them in order to get some broad trends.

The second approach studies the functioning of the agrarian sector over time and locates the changes in its trajectory of growth over time. The growth trajectory can change either in the level of the economy or annual increments (slope). (Balakrishnan and Parameswaran (2007), Virmani (2005) Ghosh (2002). Thus break point identified endogenously from the data. There were few studies that used the endogenous method to identify the break points from the series.

3.3.1 Literature on Exogenous Identification of Break Points:

Pre-and Post Green Revolution Phase:

The performance of Indian agriculture was analysed by demarcating the whole period (since the introduction of new technology up to 1974-75) into two phases (Dasgupta 1980). The first phase comprised of 1966-67 to 1970-71 and the second phase comprised of 1971-72 to 1974-75. The first phase was characterized by mood of optimism as wheat and rice together helped in increasing the food production significantly, where as the second phase was characterized by pessimism as the HYV programs seemed to have reached a state of stagnation. The comparison of growth rate in pre and post green revolution period suggests that despite of technological changes in Indian agriculture, the growth rate of income was relatively low in post green revolution period as compared to the growth rate in the pre green revolution period. Another study by Dev (1987), investigated the growth performances of foodgrain production in India for the period 1960-61 to 1984-85. The whole period was divided into three sub periods- 1960-61 to 1969-70, 1970-71 to 1979-80 and 1980-81 to 1984-85. The study observed that the weather adjusted growth rate of foodgrain production showed no acceleration during the 1970s as opposed to that of 1960s. On the other hand the growth rate increased significantly in the first half of the 1980s.

The growth performance of agriculture in Orissa was analyzed from 1950-51 to 1997-98 by Gopangana (2003). The study divided the entire period into three different phases. The first period clubbed 1950-51 to 1974-75 and was characterized without having any perceptible economic and political events in the country. The second phase comprised from 1975-76 to 1984-85 and started with an imposition of national emergency in the country. The third

phase comprised from 1985-86 to 1997-98, where the idea of reforming the Indian economy was conceived. The study suggested that the growth rate of the primary sector remained stagnant over the phases[2]. Agricultural Net State Domestic Product (NSDP) growth rate remained stagnant at 0.01 in each phase. The annual average growth rate of agriculture and animal husbandry was 0.01 in the first two phases and in the third phase it diminished by -0.01% per annum.

In order to measure whether the growth rate accelerated or decelerated, Bhalla and Singh (1997), examined the performances of Indian agriculture and conveniently divided the period 1962-92 into three phases: first phase (1962-65 to 1970-73), second phase (1970-73 to 1980-83), the third phase (1980-83 to 1992-95) (they used triennium average data). The result revealed that the growth rate of crop output across India increased from 2.08 percent in the first phase to 2.38 percent in the second phase. The third phase marked a turning point in India's agricultural development as the agricultural growth induced by HYV-technology penetrated to all regions of India. This result was again supported by Subrahmanyam and Sekhar, (2003), Swant and Achuthan, (1995), Reddy, Katyal, Reddy and Rao (1998); that the growth rate after the 1980s[3] was higher as compared to the early phase of green revolution[4]. The second phase of green revolution (1980s) was considered as the best period for Indian agriculture which triggered in a significant acceleration in output growth and reduction in regional inequalities.

Pre and Post Economic Reform:

[2] The average growth rate of primary sector in Orissa was 0.01 over all the three phases.
[3] The phase after 1980 is termed as second phase of green revolution.
[4] The phase after 1970s is termed as the early phase of green revolution.

There are different opinions regarding the growth rate of crop output or State Domestic Product (SDP) in the pre and post reform period. The study by Swant (1997) and Swant and Achuthan, (1995), suggest that the growth rate crop output before 1980-81 was 3.22 percent, and it rose to 3.27 percent in the period 1981-82 to 1994-95 across India. Ghosh (2002), divided the whole study period into three phases: the first phase (1950-51 to 1964-65), second phase (1967-68 to 1987-88), and the third phase (1988-89 to 1999-00). The growth rate in the first phase was 2.62 percent but it declined to 2.49 in the second phase. In the third phase the growth rate increased marginally to 2.64 percent compared to the preceding phases. Subrahmanyam and Sekhar, (2003) considered SDP as an indicator to estimate the growth performance at all India level. Their result indicates that the growth rate of SDP, not only accelerated significantly from pre-1981 period to post-1981 period but it continued unabated beyond 1990-91. Bhattacharya and Sakthivel, (2004), calculated the growth rate of agricultural Gross Domestic Product (GDP) for 1980s and 1990s across India. According to them the growth rate of GDP which was only 2.95 percent in the 1980s, accelerated to 3.33 percent with the initiation of economic reforms in the country in 1990s.

The analysis of growth performance in Andhra Pradesh for the pre and post reform period exhibits that it was among the few states in the country which heralded the green revolution. Agricultural sector in the state registered a growth rate of 2.21 percent in the 1980s and an insignificant increase in the growth rate after the period to 2.47 percent in 1993-94 to 2000-01 (Rao and Dev, 2003).

On the contrary to the above results, another set as literature suggest a decline in growth rate of agricultural sector in the post 1990s. The comparison of growth rate in the pre and post liberalization period showed that when the entire period of 1990s was considered, there was clear deceleration in agricultural growth in contrast to earlier phase. The growth rate of GDP from agriculture declined from 4.2% in 1980s to 3.7% per annum in 1990s which clearly substantiates the above argument (Economic Survey 2003). Mathur, Das and Sircar (2006), asserted that there has been a consistent decline in growth of the agriculture sector since 1990s when compared to the growth in 1980s. The study indicated a 4 percent growth per annum during the 1980s on an average which receded to 3.2 percent during the 1990s and a further fall to 2 percent in the last five years. The similar type of result exhibited by

Ahluwalia (2000) who calculated the pre and post reform growth rate of major Indian states (the data covers from 1980-81 to 1997-98). His study also exhibits a decline in the growth rate for all major states in post reform period.

Decadal Analysis:

The decade wise growth performance of agricultural SDP in fourteen major states of India was calculated by Ahluwalia (2000). The study divided the whole period into two sub periods. The first phase was from 1980-81 to 1990-91 and termed as the pre- reform period. Second phase range from 1991-92 to 1997-98 and termed as the post reform period. The states like Bihar, Uttar Pradesh, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, Haryana and Punjab indicated a decline in the growth rate of agricultural SDP in the post reform period. The rest of the states like Rajasthan, Madhya Pradesh, Kerala, West Bengal, Gujarat and Maharashtra showed acceleration in the growth rate of agricultural SDP in the period after reform.

The growth rate of agricultural income in Andhra Pradesh was calculated by diving the whole period from 1957-58 to 1998-99 into four different phases (Subrahmanyam and Sekhar, 2003). The first phase being the pre-green revolution phase (1957-58 to 1968-69), the second phase represented the first part of green revolution (1970-71 to 1979-80), the third phase represented the second part of green revolution (1980-81 to 1989-90) and the liberalization phase ranged from 1990-91 to 1998-99. The growth rate in the pre green revolution phase was 0.73. There was significant increase in the growth rate to 2.72 percent in the first phase of green revolution; it again increased to 2.91 percent in the second phase of green revolution. They thus suggested that Andhra Pradesh attained acceleration in agricultural growth in first and second phase of green revolution where as, the liberalization phase showed a notable decline in the growth rate to 1.32 percent.

The phases, as identified in the literature, are based on economy wide indicators like the provision of irrigation, green revolution, economic reform etc. This chapter would like to analyze the phases endogenously, not at economy wide level but at a state level. An attempt

has been made here to answer the question that does the agricultural sector in the states also witness phases corresponding to national level in response to different policy regimes?

3.3.2 Literature on Endogenous Analysis of Break Points:

An attempt was made by Balakrishnan and Parameswaran (2007), to locate the turning points of economic growth since 1950s, by applying some statistical tools in the data series. The study estimated the break points of income from primary, secondary and tertiary sector. All the components of GDP witnessed acceleration in the growth rate. The break points estimated allowing for shift in the intercept along side change in slope. The growth rate of overall GDP showed only one shift in 1978-79 where as agricultural growth showed a trend break in 1964-65 when growth accelerated. The estimates of a structural break came with an associated confidence interval. So, the break point took place "some time in the mid-1960s". According to the study the acceleration in the growth rate after the break point was not solely because of green revolution, it also came due to the expansion in the irrigated area in the decade and half preceding the mid 1960s.

The performance of Indian economy and the structural shift in the agricultural sector was discussed by Virmani (2005) with the help of the statistical tool. He used the statistical tool chow test to calculate the break points in the total Gross State Domestic Product (GSDP) series as well as GSDP from agriculture, industry and service sector. The study found only one break point in the total GSDP series of India along with the effect of rainfall. The agricultural GSDP using the chow test found only one break point in 1964-65. Again, introducing a dummy for the year 1964-65 the test showed insignificant coefficient. Thus, the study concluded that the agricultural GSDP in India did not witness any statistical break in the growth of GSDP from agriculture during the period of 53 years, once the variation in rainfall are taken into account.

Ghosh (2002), examined whether the movements in the series have been generated by big shocks or by accumulation of frequent shocks each of which has permanent effect. Indian agriculture in the post independence period was characterized by the change in the presence of several shocks, one does not know exactly when the optimal date of change occurred. The

testing for a unit root to estimate the breakpoints objectively for agricultural GDP, output and yield of rice, foodgrains and all crops, the unit root hypothesis was rejected at 1 percent level of significance for 1964-65 and 1987-88. The coefficient of shift dummy was also found to be significant for these variables. These results suggested that the most significant structural break in the level and the trend functions of output and yield of rice, foodgrain and all crops occurred in 1964-65, at the end of which severe drought occurred in the two consecutive years. The second most significant break occurred in 1987-88. Since, rice is the dominant crop among foodgrains and foodgrain is the dominant in all crops, thus the breakpoint in foodgrain, total crops output and yield coincides with those of rice. It can also be noticed that the years of structural break for GDP from agriculture series coincided with those of the output and yield of rice, foodgrain and all crops. Even though HYV technology was introduced in the mid-1960s such technology was unable to cause a significant break either in the level or in the slope of the trend function of these variables. The nature of structural break found in mid-1960s was different from that in the late 1980s. The level of trend function of these variables declined significantly as a result of drought in mid-1960s, it occurred conceivably due to the spread of new technology to all regions of India in the late 1980s. This result indicated that the effect of dissemination of new technology in Indian agriculture could be felt in higher levels of output and yield of these crops only after 1987-88.

There are a few studies which have attempted to analyse the structural break in the agricultural sector endogenously from the data series. The studies basically used statistical tool of 'unit root method' or 'dummy variable method' or 'chow break point test'. This present study used the 'chow test' as measure to find the break point and attempted to analyse the break points in the agricultural income series not with the help of the changes brought out by the intervention of the government policies but by analyzing it endogenously from the data series.

Section: IV Methodology to Study Breaks:

The growth rate of net state domestic product originating from agriculture, was estimated by using exponential function $\text{Ln } Y_t = a + gt + u_t$, where Ln Y, g, t and u denotes log of income, instantaneous growth rate (from the instantaneous growth rate we have calculated the

compound growth rate), time trend and random disturbance term respectively. A break in the series represents a change in the parameters of the regression model i.e., 'a' and 'g' necessitating identification of the break point.

Empirical studies on the growth performance have attempted to identify turning points in growth and in the process tend to identify phases in the performance of the economy. The conception being that the different phases have distinct nature and pattern of growth. There are two broad methods of identifying break periods. In one method, the break year is identified in terms of some 'exogenous' event, which is expected to influence significantly the target variable. For example, in case of agriculture it could be the occurrence of some exogenous events such as introduction of HYV technology or new economic policy. In this case, the choice of the break point is the subjective choice of the individual researcher. In case of Indian agriculture the exogenously identified break are green revolution (Dasgupta 1980, Dev 1987) or economic reforms (Ghosh 2002, Swant 1997 and Swant and Achuthan 1995) or decadal analysis (Subrahmanyam and Sekhar, 2003). The second method could broadly be defined as 'let the data speak' or an endogenous analysis. Here again there are two approaches to identity the turning points in the data.

In one approach, the turn points are identified based on identification of points(s) of inflection in the graph of the series. The second is to test for statistically significant differences in the parameters across two periods, generally referred to as the 'Chow test'. "Chow test' is a one of the methods used to test for 'parameter stability' in the period of analysis. The present study calculated chow statistic to test the stability of the coefficient of regression equation. The robustness of the chow test depends on the assumption that the error variance be the same for the two regressions. If this condition is not satisfied the chow test may be inaccurate. We have tested whether the error variance are the same for our regression equation using F-statistics value which make use of residual of the estimated regression equations.

The Chow test assumes that we know the points(s) of structural break. The present study applied the Chow test to every data point and subsequently identified the break point in the

data series. The Chow test is to apply the test to all the possible data points and accept the data point which has the highest F-statistics. A repeated application of chow test might give breaks in consecutive years. In such a case the value of F-statistics is used to validate the break year.

The estimates of structural break come with an associate confidence interval, so we need not hold fast to the point estimate. If there is a policy change, one may not expect an instantaneous change in the performance indicator. An agent has to incorporate the change and may respond to it and there may be a threshold level which needs to be reached before the aggregate economy can respond. To cite an example, the introduction of subsidized green revolution package was a policy intervention of the State. There would exist a time before the policy is accepted by the farmers and they start to cultivate the crop using HYV seeds. This gestation period could be different in different states and would depend not only on the policy but also on the structure of the economy. So one may find a band i.e. a set of data points wherein, the change takes place.

The different break points that identified in the net income from agriculture series can be the aggregation of break points in the area or yield or crop diversification. Total income or output can increase either by increasing the area under cultivation or by increasing the amount of yield in the same amount of land or by shifting from low value crop towards high value crop production. Thus total income of the state is the aggregation of the growth rate achieved in increase in area, yield and by diversification of crop. The break points in net income from agriculture results due to structural break in the area under cultivation or structural change in yield or due to crop diversification. So the growth of agricultural income can be disaggregated into a set of physical factors viz. area, yield and crop diversification. The present study considered the index numbers of area, yield[5] and crop diversification (Gupta and Tewari 1985, Kurosaki 1999, Kurosaki (2003), Kalamkar and Pradhan 2004) in stead of the actual data in order to conduct an aggregate analysis. The present study considered cropping pattern diversification as a proxy to the cropping pattern change in the states.

[5] The studies used the index of area and yield are Giri, Sastri and Somayajulu (1969), Rahu and Rao (1988), Tripathy (1990)

The index numbers of area, yield and production was calculated by taking 1998-99 as the base year. The data regarding index numbers of crops were not available with a single base year, so the present study converted the series by using 1998-99 as the base. The formulas used for the calculation of indexes are explained below.

$$\text{Index of Area under Crops} = \frac{\sum a_{ij}}{\sum a_{i0}} \times 100$$

$$\text{Index of Yield} = \frac{\sum a_{ij}\, y_{ij}\, P_{i0}}{\sum a_{ij}\, y_{i0}\, P_{i0}} \Big/ \frac{N_i}{N_0} \times 100$$

where a_{i0} = Area under i^{th} crop in the base year.
a_{ij} = Area under i^{th} crop in the jth year.
N_0 = Net Area Sown in the base year.
N_j = Net Area sown in the j^{th} year.
y_{i0} = Yield per hectare of i^{th} crop in the base year.
y_{ij} = Yield per hectare of i^{th} crop in the jth year.
P_{i0} = Price per unit of i^{th} crop in the base year.

Several methods are available in the literature for calculating the extent of crop diversification. The most commonly used methods are Herfindahl Index and Theil's Entroy Index. The present study used the Herfindahl index (termed as H index) for analyzing the diversification index.

Herfindahl index is defined as:

$$H = \sum_{i=1}^{n} p_i^{\,2}$$

P_i = Proportion of area under i^{th} crop.

$$= A_i \Big/ \sum_{i=1}^{n} A_i$$

Where A_i = Area under i^{th} crop

$\sum_{i=1}^{n} A_i$ = Total cropped Area

i=1

The value of H index varies between zero to one (Gupta and Tewari 1983, Kurosaki 1999, Kurosaki (2003), Kalamkar and Pradhan 2004). It takes the value one in case of perfect specialization and zero in case of perfect diversification. So, with the increase in diversification the H index would decrease. This index takes the value one when there is a complete specialization and approaches zero as 'N' gets larger i.e. if the diversification is perfect. Thus, the Herfindahl index is bounded by zero and one. It is the measure of concentration, it is transferred by subtracting from one i.e. 1-H.

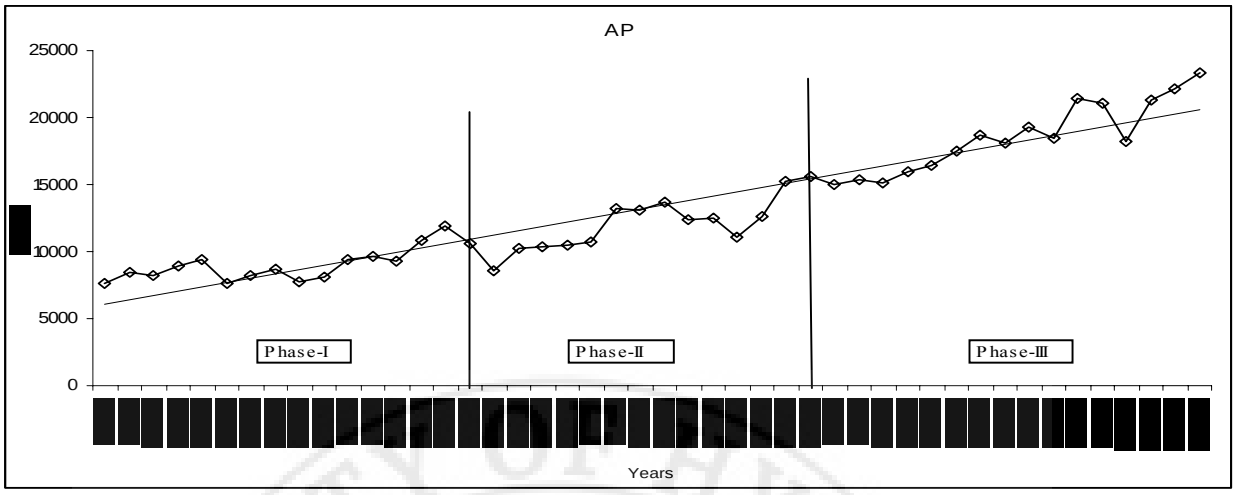
Section V: Identification of Phases in the Two States:

3.5.1 Whole Period Analysis:

The net income from agriculture in Andhra Pradesh showed an increasing trend with minor fluctuations (figure: 3.1). The figure: 3.2 represent the trend of agricultural income in Orissa. The figure shows the net income from agriculture in Orissa increased till the 1990, but it showed a deceleration in the income trend after the post reform period. The income from agriculture became more variable during 1970s compared to the earlier period in Orissa.

The net income from agriculture at constant price was 7657 crores in 1960-61 in Andhra Pradesh. It increased to 23377 crores in 2005-06 in the state. The income from agriculture witnessed an increase of nearly 205% in the period of analysis for Andhra Pradesh (Table: 3.1). The net income from agriculture at constant price in Orissa was 3383.44 crores in 1960-61; it increased to 6705.03 crores in 2005-06. The agricultural income in Orissa showed an acceleration of 98.17% in the whole period. This shows that the rate of increase in the agricultural income in Andhra Pradesh was higher than Orissa.

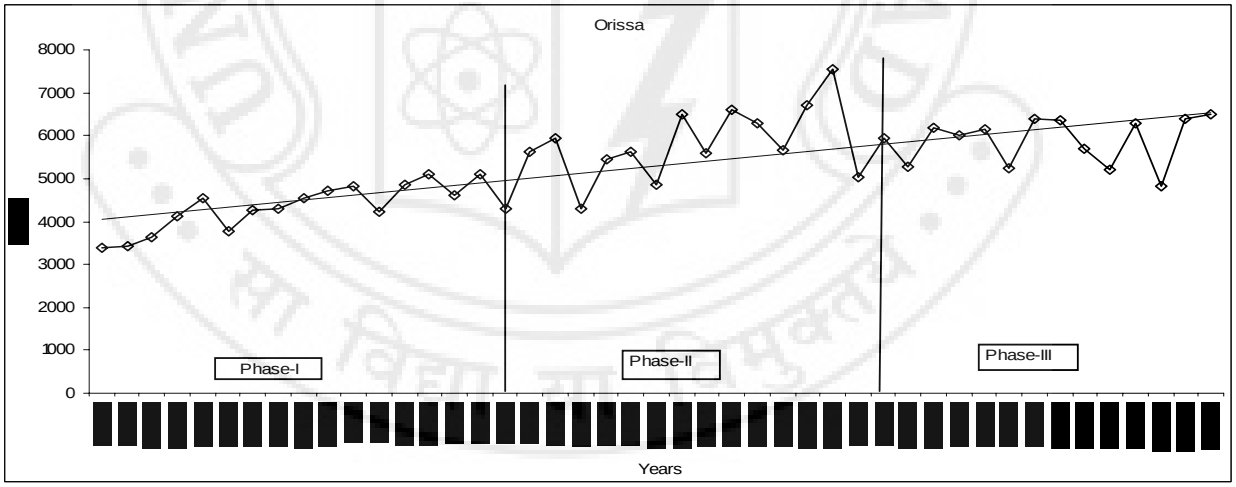
Figure: 3.1 Trend of Agricultural Income in Andhra Pradesh (1960-61 to 2005-06):



Source: Statistical Abstract of Andhra Pradesh, various issues.

Rate of growth of income from agriculture in Andhra Pradesh and Orissa was 2.42% and 1.14% respectively for the specified time span between 1960-61 to 2005-06 (Table: 3.1). The compound growth rate of net income from agriculture in Andhra Pradesh was significantly higher as compared to the growth rate of income in Orissa.

Figure: 3.2 Trend of Agricultural Income in Orissa (1960-61 to 2005-06):



Source: Statistical Abstract of Orissa, various issues.

Table: 3.1 Growth Rate of Net Income from Agriculture in Two States for the Whole Period:

NSDP (crore)	Value in 1960-61	Value in 2005-06	Percentage change	Growth Rate

Andhra Pradesh	7657.62	23377.75	205.26	2.42 (20.19)
Orissa	3383.44	6705.03	98.17	1.14 (7.77)

Note: The figures in the brackets are the t-statistics values.
Source: Statistical Abstract of Andhra Pradesh and Orissa, various issues.

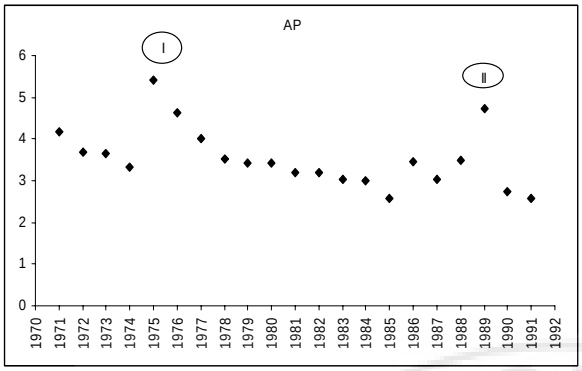
Looking at the graphs one gets an impression that both the states have more than one break point in the period of analysis. Thus an attempt has been made in the following section to identify the phases in the growth rate of agricultural income for two states. One could apply the chow test repeatedly to all points to get information on the year of turn around in the agricultural income series for the two states.

3.5.2 Phase-wise Analysis:

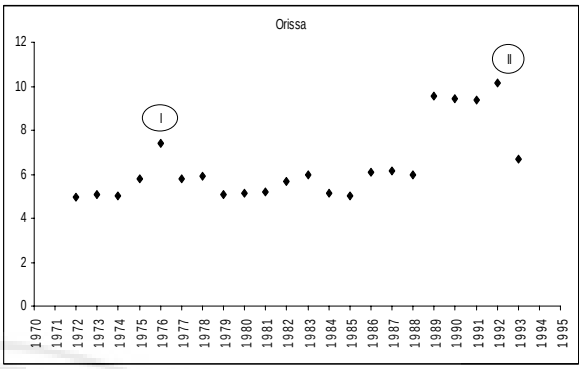
The entire period from 1960 to 2005 was divided into different phases by using chow break point test. The Chow test used in this present study delivers multiple breaks for the series of income from agriculture in both the states. Andhra Pradesh agricultural income witnessed break point some time in the mid 1970s. There exist structural shift in between the period 1973 to 1977. The year 1975 was accepted as a structural break year at 1 percent level of significance (the F-statistics value is 5.41 and the probability value is 0.015). The second structural break in the series was on 1989. The process of structural shift found in between the period 1986-87 to 1991-92. The year 1989 was accepted as a break year at 1 percent level of significance (the F-statistics value is 4.74 and the probability value is 0.012). The series of agricultural income witnessed multiple breaks for the whole period. The study accepted only two break points having highest F-statistics value. F-statistics values for different periods are plotted in the figure: 3.3 for both the states. The figure 3.3.a presents the f-statistics values in different periods starting from 1970 to 1991. The year 1975 and 1989 accepted at 1 percent level of significance and with highest f-statistics value. Thus the first phase of Andhra Pradesh agricultural income was from 1960-61 to 1974-75, the second phase was from 1975-76 to 1988-89 and the third phase ranges from 1989-90 till 2005-06.

Figure: 3.3 Value of F-Statistics at Various Points of time in Two States:

(3.3.a)



(3.3.b)



The values of F-statistics at different points of time in Orissa are plotted in the graph 3.3.b. The net income series in Orissa also delivers multiple break points. The break points observed in the starting of 1970s, were with 10 percent level of significance. Multiple breaks points with 1 percent level of significance were found from the mid 1970s. The process of structural shift in Orissa occurred in the period from 1974-75 to 1977-78. The year 1976 was accepted as a structural break year with highest F-statistics value and at 1 percent level of significance (the F-statistics value is 5.78 and the probability value is 0.008). The second break was accepted in the year 1992, because the process of structural transform occurred in between 1989 to 1993. The year 1992 was considered as a break point with higher F-statistics value and at 1 percent level of significance (Probability value is 0.0006 and F-stat is 8.77). The first, second and third phase in Orissa are compartmentalized into 1960-61 to 1975-76, 1976-77 to 1991-92 and 1992-93 to 2005-06 respectively.

The percentage change of net income in each phase is presented in the table 3.2. The net income at constant price in Andhra Pradesh was 7657 crore in 1960-61. It increased to 11866.40 crore in 1974-75. There was around 55% of change in the agricultural income from the starting year compared to the ending year of the first phase for Andhra Pradesh. In the beginning of the second phase there was decline in the agricultural income at constant price to 10620.08 crore. But it witnessed 43% of increase and remained 15198.67 crore in 1988-89. In the beginning of the third phase the net income from agriculture was 15554.92 crore, it raised to 22377.75 crore in 2005-06. The rate of increase of agricultural income in the third phase was 50.49%.

The agricultural income growth rate in each phase indicates that, in Andhra Pradesh the growth rate of income from agriculture showed an increasing trend. The growth rate of net income from agriculture in the second phase was substantially higher in the state compared to the first phase whereas the growth rate achieved in third phase was not impressive. The growth rate achieved in the second phase in the state was 2.76% and it increased marginally to 2.80% in the third phase.

Table: 3.2 Growth Rate of Agricultural Income in Each Phase for Andhra Pradesh and Orissa:

Phases	Income from Agriculture at the Starting and the Ending Years in Each Phase (crore)		Percentage Change	Growth Rate
Andhra Pradesh				
Phase-I	1960-61	7657.62	54.96	**2.01**
	1674-75	11866.40		(3.57)
Phase-II	1975-76	10620.08	43.11	**2.76**
	1988-89	15198.67		(5.66)
Phase-III	1989-90	15554.92	50.49	**2.80**
	2005-06	22377.75		(8.21)
Orissa				
Phase-I	1960-61	3383.44	54.19	**2.20**
	1975-76	5216.78		(4.88)
Phase-II	1976-77	4309.23	37.76	**1.72**
	1991-92	5936.83		(2.30)
Phase-III	1992-93	5269.43	23.04	**0.26**
	2005-06	6483.53		(0.33)

Note*:* Numbers in brackets are the t-statistics value.

Source: Statistical Abstract of Andhra Pradesh and Orissa, various issues.

The net income from agriculture in Orissa increased from 3383.44 crore in 1960-61 to 5216.78 crore in 1975-76. The first phase indicated 54% of change in the agricultural income in Orissa. The rate of change of income declined to 37.76% in the second phase. There was decline in the income from agriculture in Orissa at the beginning of the second phase compared to the last year of the first phase (4309.23 crore in 1976-77), and it increased to 5936.83 crore at the end of the phase. The third phase indicated sharp decline in the agricultural income from 5269.43 crore in 1992-93 to 4830.01 crore in 2002-03, whereas in 2005-06 there was increase in the net income from agriculture to 6483.53 crore. The third phase showed only 23% of increase in the net income in Orissa. This illustrates that the income from agriculture in Orissa at the constant price, declined over the phases.

Thus the growth rate of agricultural income in Orissa witnessed continuous decline from one phase to other. In the first phase the agricultural income growth rate in Orissa was 2.29%, it declined to 1.72% in the second phase. The growth rate of net income from agriculture in the third phase was lowest with 0.26%, which showed a positive but insignificant growth.

The analysis of agricultural income growth rate in two states shows that Andhra Pradesh witnessed higher rate of growth compare to Orissa for the whole period. The growth rate of income from agriculture for two states was approximately same in the first phase. However the agricultural income growth rate witnessed opposite trend in two states. The growth rate of agricultural income in Andhra Pradesh demonstrated increasing trend though the increase in second phase to third phase was not adequate. More precisely the growth rate of income from agriculture in the third phase showed insignificant increase compared to the growth rate in second phase. On the other side the growth rate of agricultural income in Orissa witnessed a constant decline from one phase to other. In a nutshell the trend of agricultural income growth rate did not follow a similar direction in both the state.

Section: VI Factors Accounting for Break Points in Agricultural Income in Two States:

The two states witnessed two turn points and have three phases. The identification of the factors that influence the structural break points is an important study. This section makes an effort to find out the break points in area, yield and crop diversification and subsequently analyses the factors that generates the break points in income series. An attempt has been made here to understand whether the break point at the aggregate level is area led or yield led or diversification led growth. The structural break points for the different indices are calculated endogenously from the data.

3.6.1 Trend of Area, Yield and Crop Diversification Index in Two States for the Whole Period:

3.6.1.1 Trend of Area Index in Andhra Pradesh and Orissa:

The index number of area in Andhra Pradesh declined over the period (Figure: 3.4). The index of area in the state was 87.30 percent in 1960-61; it declined to 84.72 percent in 2003-04. In 2005-06 there was marginal recovery in the index of area to 89.23 percent in 2005-06. The growth rate of area index in Andhra Pradesh was negative (-0.04) for the specified period of time.

Contrary to the trend of area index in Andhra Pradesh the index number of area in Orissa showed an increasing trend till mid 1990s (figure: 3.7). There was downward shift of the curve after the period 1995. The index number of area in Orissa was 64.97 percent in 1960-61; it increased significantly to 111.45 percent in 1995-96. There was decline in the index number of area to 95.35 percent in 2005-06. The growth rate of area index illustrated a positive (0.86%) and significant growth rate in the overall period.

3.6.1.2 Trend of Yield Index in Andhra Pradesh and Orissa:

The trend of yield index in the two states is presented in the figure: 3.5**.** The index of yield in Andhra Pradesh showed an upward shifting curve over the time span. The yield index demonstrated minor decline in the curve till seventies in Andhra Pradesh. But after1970s it took the upward trend till 2005-06. The yield index was 55.72 percent in 1960-61 it increased to 105.22 in 2005-06. The growth rate of yield index was 1.59 percent in Andhra Pradesh for the whole period which is positive and significant.

The trend of yield index in Orissa was nearly stagnant till mid seventies but after this period there was an upward movement of the curve, again after mid 1990s the yield index witnessed a downward trend in Orissa (figure: 3.8). The index number of yield was 81.76 percent in 1960-61, it increased to 124.22 percent in 1995-96, and in 2005-06 the index of yield was 81 percent. The growth rate of yield in Orissa was 0.76 percent for the whole period.

The comparison of yield index in two states shows that the growth rate of yield index in Andhra Pradesh was higher than the growth rate in Orissa in the specified period of time.

3.6.1.3 Trend of Crop Diversification Index in Andhra Pradesh and Orissa:

Over the period, Andhra Pradesh witnessed increase in the diversification of crop cultivation. The H-index was 0.20 in 1960-61 it declined to 0.11 in 2005-06. This implies that there was diversification of crop cultivation in Andhra Pradesh in the 2005-06 compare to the 1960s. There can be different reasons behind the diversification of crop[6]. The development in market infrastructure and certain other prices related supports leads to crop shift. The Cultivation of low volume high-value crops like chilies and cotton witnessed increase in the area under cultivation in Andhra Pradesh.

The H-index curve in Orissa showed increasing trend till 1972 (figure: 3.9). The value of H-index approaches towards one, implying crop specialization in the state. After 1970s the H-index witnessed decline in the curve till 1990s but it increased after the period. The acceleration in the H-index after 1990s implies decline in crop diversification. There was specialization of crop cultivation towards rice and other cereals in the state (Economic Survey 2005). The H-index was 0.38 in 1960-61, it declined to 0.24 in 1980-81. The H-index for Orissa increased after 1995 from 0.24 to 0.36 in 2005-06. This indicated that from mid seventies till nineties there was increase in crop diversification in the state but after the period the state witnessed specialization of crop which indicates the concentration of mono

[6] With the advent of modern agriculture technology, especially during the period of green revolution in the late sixties and early seventies, there is a continuous surge for the diversified agriculture in terms of crops, primarily on economic consideration. The crop pattern diversification however are the outcome of the interactive effects of many factors which can be broadly classified into five types:

a) Resource related factors covering irrigation, rainfall, and soil fertility.
b) Technology related factors covering not only seeds, fertilizer and water technologies but also those related to marketing, storage and processing.
c) House hold related factors covering food and fodder self sufficiency requirement as well as investment capacity.
d) Price related factors covering output and input prices as well as policies and other economic policies affects these prices either directly or indirectly.
e) Institutional factors covering farm size and tenancy arrangement, research, extension, and marketing system and govt. regulatory policies.

crop cultivation. This may be because the increase in the total area under cultivation leads to increase in the area under one particular crop rather than different crops.

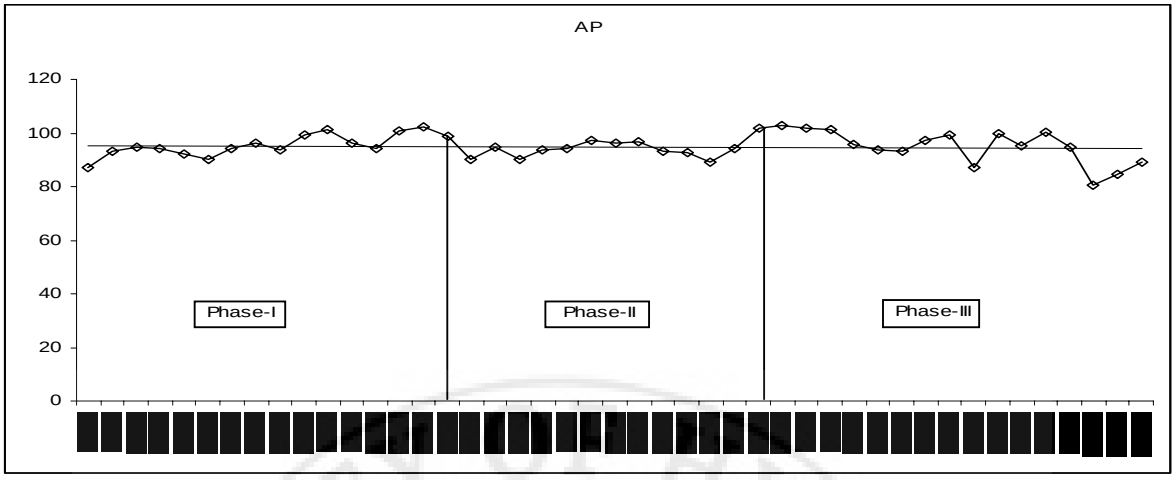
3.6.2 Break Points in Area, Yield and Diversification Index in Andhra Pradesh and Orissa:

The structural breaks for the index numbers of area, yield and crop diversification was calculated endogenously from the data. The structural change in the trend of area, yield and crop output, ultimately reflect the break point in the agricultural income curve either in a led or lag manner. The 'chow break point test' is used to find the break points in index numbers of area, yield, production and cropping pattern.

3.6.2.1 Break Points in Index Number of Area, Yield and Crop Diversification in Andhra Pradesh:

The index number of area witnessed multiple breaks in between the period 1971 to 1977. The year 1975 was considered as the break year with highest F-statistics value (F statistics 5.11 and Probability value 0.010). The second structural shift for the area index was witnessed in between the period 1987 to 1990. The year 1988 was considered as the break year with the highest F-statistics value (F-statistics value is 8.52 and probability value is 0.001). The first break point in the area index witnessed a decline in trend after 1975-76. The first break point that was observed in the series of area index coincides with the break point in the income series. The second break point in the area index series precedes the break point in the income series. A decline in the trend was observed after the second break point in the area index series. The growth rate of area index was 0.76% in the first phase i.e. from 1960-61 to 1974-75 (Table: 3.3). There was a decline in the growth rate in the second phase to -0.25% again in the third phase there was negative growth in the area index to the level -0.94% (Table: 3.4).

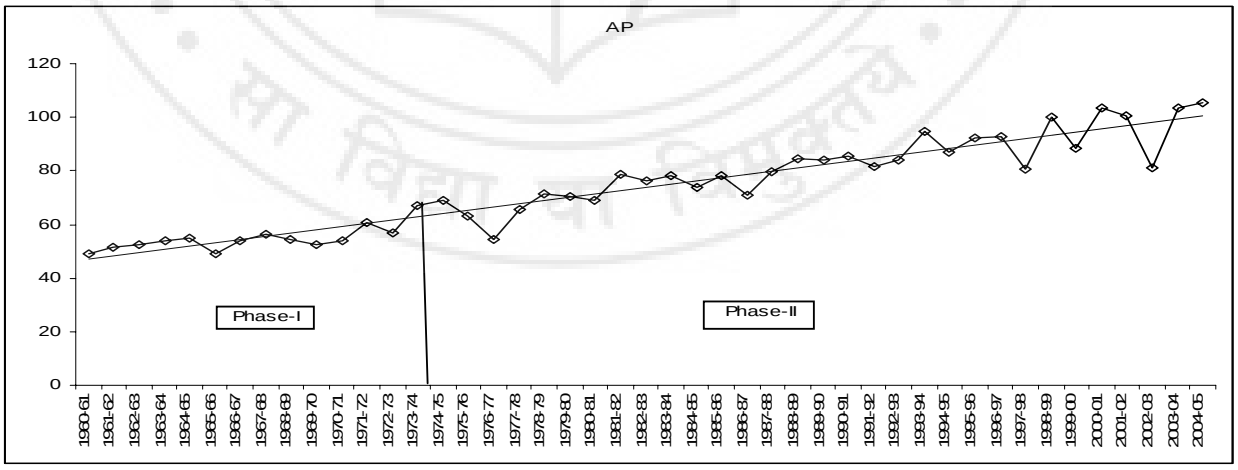
Figure: 3.4 Trend of Area Index in Andhra Pradesh (1960-61 to 2005-06):



Source: Statistical Abstract of Andhra Pradesh

The Index number of yield witnessed multiple breaks in between 1971 to 1974 (Table: 3.4). The year 1973 was considered as the break year with highest F-statistics value (F-statistics 4.82, probability value 0.01). After 1973 there was continuous acceleration in the trend of yield index. So, the index of yield in Andhra Pradesh witnessed two phases, the first phase ranged from 1960-61 to 1972-73 and the second phase was from 1973-74 to 2005-06 (Table: 3.3). The growth rate of yield index was 0.14% in between the period 1960-61 to 1972-73, it increased to 1.52% in the second phase. The index of yield demonstrated an increasing trend in the second phase as compared to the first phase (Table: 3.3).

Figure: 3.5 Trend of Yield Index in Andhra Pradesh (1960-61 to 2005-06):



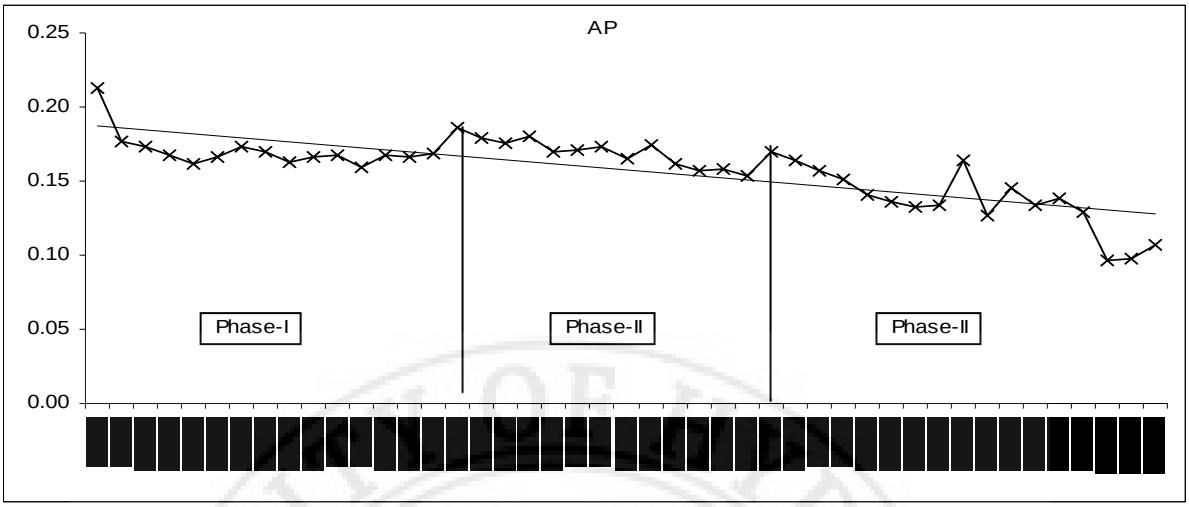
Source: Statistical Abstract of Andhra Pradesh

Table: 3.3 Growth Rates of Index Numbers in Each Phase in Andhra Pradesh:

Andhra Pradesh		Phase-I	Phase-II	Phase-III	Whole period
Index of Area	*Phases*	*1960-61 to 1974-75*	*1975-76 to 1987-88*	*1988-89 to 2005-06*	
	Growth Rate	*0.76*	*-0.25*	*-0.94*	-0.04
Index of yield Yield	*Phases*	*1960-61 to 1972-73*	*1973-74 to 2005-06*		
	Growth Rate	*0.14*	*1.52*		1.59
H-Index	*Phases*	*1960-61 to 1974-75*	*1975-76 to 1987-88*	*1988-89 to 2005-06*	
	Growth Rate	*-0.69*	*-1.52*	*-2.48*	-0.92

The diversification index (H-index) in Andhra Pradesh also witnessed two break points. The first structural break period in the index of crop diversification was found in between 1972 to 1977. The year 1975 was considered as the structural break year with highest F-statistics value (F-statistics value 17.18 and the probability value 0.000) (Table: 3.4). The second series of break point in the diversification series was in between 1987 to 1990. The year 1988 was accepted as the break year with highest F-statistics value i.e 15.96 and the probably value was 0.0001. The H-index witnessed decline in the trend line (as presented in the figure: 3.6) after 1975-76. The decline in the H-index implied the increase in the crop diversification in the state after 1975-76. The H-index after 1988-89 also witnessed sharp decline in the trend. The decline in the trend of H-index implies the increase in the crop diversification in the state after the 1988-89. The growth rate of H-index declined in the second phase (1975-1987) to -1.54%, compared to the growth rate in 1960-61 to 1974-75 (-0.69%). There was again decline in the growth rate in the third phase to the level -2.42% (Table: 3.3). In other words there was an increase in crop diversification in Andhra Pradesh in the second phase compared to the first phase.

Figure: 3.6 Trend of Diversification Index in Andhra Pradesh (1960-61 to 2005-06):



Source: Statistical Abstract of Andhra Pradesh

Table: 3.4 Estimated Break Dates of Index Numbers in Andhra Pradesh:

	First break	Second break
NSDP from Agriculture	1975/76 (+) 1973/4 -1977/78	1989/90 (+) 1986/8 – 1991/92
Index Number of Area	1975/76 (-) 1971/72 – 1977/78	1988/89 (-) 1987/88 – 1990/91
Index Number of Yield	1973/74 (+) 1971/72 – 1974/75	
Index Number of Crop Diversification	1975/76 (-) 1972/73 – 1977/78	1988/89 (-) 1987/78 – 1990-91

Notes: the plus and minus, in parenthesis, indicate acceleration and deceleration respectively.

The net income agriculture series witnessed the first set of multiple break points in between 1973-74 and 1977-78 where as 1975-76 was accepted as the break year. Index number of area, yield and crop diversification also witnessed breaks in the same periods. The index number of area and yield witnessed break in the same year as witnessed in the income series. While the break in index number of yield precedes the break in income from agriculture series. The net income from agriculture witnessed an increase in the growth rate in the second phase as compared to the first phase, whereas the growth rate of area index decelerates in the second phase in comparison to the first phase. The growth rate of area index in the second phase was negative in contrast to the accelerating growth rate achieved

in the net income series. This implies that area may not be a major contributor for the change in growth regime of income originating from agriculture. The growth rate was thus generated due to substitution of inputs from area led growth process to yield led. In case of index number of yield one witnesses an increase in the growth in the second phase when compared to the first phase. There was also an increase in the crop diversification in this phase. So the first break in the net income series was contributed due to yield and diversification of crops.

The second series of break in the income from agriculture was between 1986- 92. The year 1989 was accepted as the break year. The Index number of area witnessed a series of break in between 1987-90 and the year 1988 was accepted as the break year. In this phase the break in the index number precedes the break in the income from agriculture series. There was deceleration in the area index after 1975, but the decline was highly significant after 1988 and it showed a negative growth. The index number of yield does not show any break in any of these years (after 1976). The acceleration witnessed from the second to the third phase in the agricultural income series thus might not be purely due to the yield index. The crop diversification index shows a multiple break between 1987-90 and the year 1988 was accepted as the break year. Here also the break in the series precedes the break in the income series. The structural break point in the income series may be the representation of the break in the crop diversification index. Thus, the third phase can be explained as the diversification phase in Andhra Pradesh.

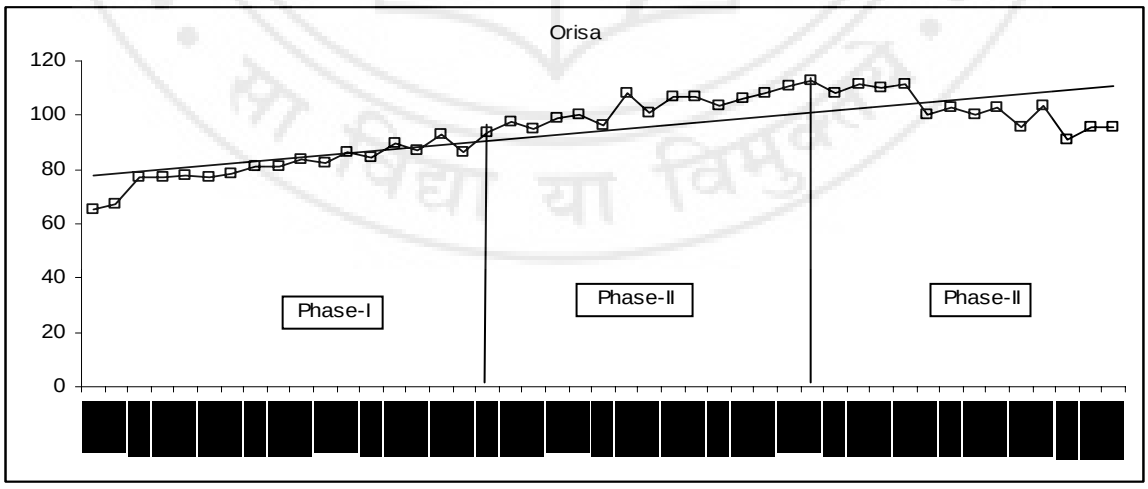
The above analysis shows that the first turn point and the acceleration in the annual rate of growth of income from agriculture roughly correspond with the breaks in yield index and increased crop diversification in the economy. The second turning point and acceleration in income from agriculture corresponds with turning point of increased crop diversification. The contribution of area to the turning points in the income from agriculture found to be negligible, whereas the contribution of yield and crop diversification assumes a more pivotal role in explaining turning points in income from agriculture in Andhra Pradesh. Given that index number of yield and crop diversification are more important in explaining the break in

income from agriculture, the growth in Andhra Pradesh economy looks to be intensive and the increased crop diversification indicated the importance of market in the economy.

3.6.2.2 Break Points in Index Number of Area, Yield and Crop Diversification in Orissa:

The index number of area in Orissa illustrates multiple breaks in the series. The first set of break points found between the period 1974-75 to 77-78 and the year 1977 was accepted as the break year. This index number of area witnessed acceleration in the growth rate after the first break. The second break in the index number of area series occurred in between the period 1985-86 to 1992-93. The year 1991 was considered as the year of break with 1 percent level of significance and highest F-statistics value (Table: 3.6). During the third phase the index number witnessed a deceleration when compared to second phase. The growth rate of area index in the period 1960-61 to 1976-77 was 1.69%, but the growth rate declined to 1.01% in between the period 1977-78 to 1989-90. This shows there was slow growth rate in the area under crop cultivation in Orissa. The growth rate was negative (-1.35) for area index in the period 1990-91 to 2005-06 (Table: 3.5). The trend of index number of area is presented in the figure 3.7.

Figure: 3.7 Trend of Index Number of Area in Orissa (1960-61 to 2005-06):



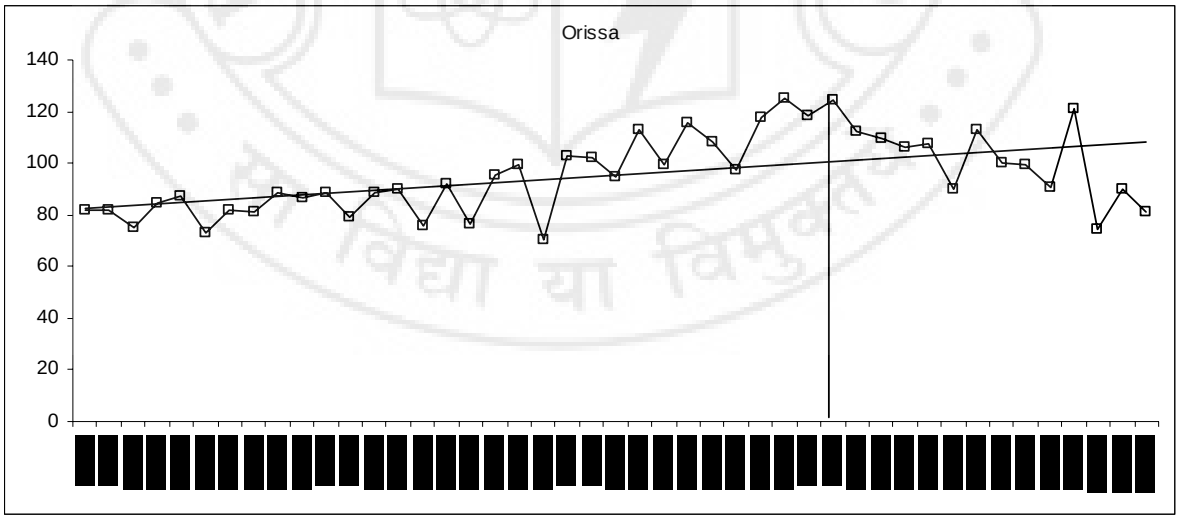
Source: Statistical Abstract of Orissa

Table 3.5: Growth Rates of Index Numbers in Each Phase in Orissa:

Orissa		Phase-I	Phase-II	Phase-III	Whole period
Index of Area	*Phases*	*1960-61 to 1976-77*	*1977-78 to 1990-91*	*1991-92 to 2005-06*	
	Growth Rate	*1.70*	*1.16*	*-1.55*	*0.96*
Index of Yield	*Phases*	*1960-61 to 1989-90*	*1990-91 to 2004-05*		
	Growth Rate	*1.28*	*-2.73*		*0.87*
H-Index	*Phases*	*1960-61 to 1976-77*	*1977-78 to 1990-91*	*1991-92 to 2005-06*	
	Growth Rate	*0.83*	*-2.02*	*3.19*	*-1.20*

Similar to the case of Andhra Pradesh the index number of yield witnessed a single break point in between the period 1985 to 1991 (Table: 3.6). The year 1990 was considered as the break year with highest F-statistics value (F-statistics value 13.06, Probability value 0.0004). There was deceleration in the yield index in the state after late 1990s (Figure: 3.8). The yield per hectare shows only one break point in the series. The growth rate of yield index was -2.13% in the period 1990-91 to 2005-06 in contrast to the positive growth rate (1.27%) achieved in the period from 1960-61 to 1989-90. This implies there was sharp decline in the growth rate of yield per hectare in the state, particularly after 1990s (Table: 3.5). There was decline in the index number of yield in the second phase when compared to the first phase.

Figure: 3.8 Trend of Index Number of Yield in Orissa (1960-61 to 2005-06):



Source: Statistical Abstract of Orissa.

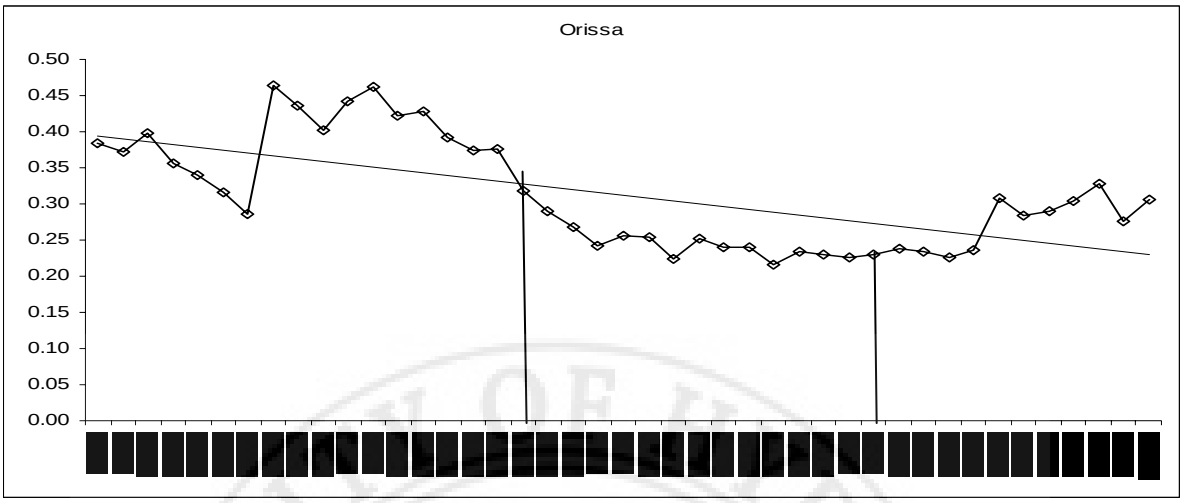
Diversification index illustrated two break points in the whole series. The first structural break for the H-index was originated in between the period 1975-1980. The year 1977 was considered as the structural break year with highest F-statistics value (29.41 and probability value 0.000). The second break in the series was found in between the period 1987-88 to 1992-93 and the year 1991 (F-statistics value 14.97 and probability value 0.0001) was accepted as the break year. The H-index witnessed acceleration in the growth rate after the break. The growth rate of H-index in the period 1960-61 to 1976-77 was 0.83% which declined to -2.02% in the period 1977-78 to 1990-91. The decline in H-index suggests that there was increase in the diversification of crop cultivation in the state after late 1970s in the state (Figure 3.9). The growth rate H-index for the period 1991-92 to 2005-06 was positive and significant (3.19%). This shows that after the negative growth rate achieved in 1977-1990, there was significant increase in the growth rate of H-index after 1991. The increase in the H-index implies decrease in the diversification and increasing the crop specialization. In the state after 1990s, there was increase in the crop specialization.

Table: 3.6 Estimated Break Dates of Index Numbers in Orissa:

Orissa	First break	Second break
NSDP from agriculture	1976/77 (-) 1975/6 – 1977/8	1992/93 (-) 1989/90 – 1993/4
Index number of Area	1977/78 (+) 1974/5 – 1979/80	1991/92 (-) 1985/6 – 1992/3
Index number of yield	1990/91 (-) 1985/6 – 1991/2	
Index number of crop diversification	1977/78 1975/6 – 1980/81 (-)	1991/92 1987/88 – 1992-93(+)

Notes: the plus and minus, in parenthesis, indicate acceleration and deceleration respectively

Figure: 3.9 Trend of Diversification Index in Orissa (1960-61 to 2005-06):



Source: Statistical Abstract of Orissa.

The first break point for the income from agriculture in Orissa was in between the period 1976-77. The growth rate of income in the phase after 1976-77 declined in Orissa as compared to the growth rate achieved before 1975-76. The decline in the growth rate of income in Orissa after 1976-77 could be due to the decline in the area, yield or diversification. The area under cultivation in Orissa showed structural break in the year 1977-78. Around the same period the diversification index also witnessed a break but the index number of yield did not witness any break. Unlike the state of Andhra Pradesh, Orissa does not witness a break in the index number of yield series in the seventies or the green revolution looks to have by-passed the state of Orissa. The index of area witnessed increased in the growth rate after the first break point (1977-78). The diversification index also witnessed a structural break in the year 1977-78. There was an increase in the crop diversification after 1977-78. Thus it shows that with the increase in the area under cultivation there was increase in the diversification of crops towards inferior cereals and oilseeds (This issue is discussed in the next chapter). But the decline in the growth rate of income in the second phase pointed out that the increase diversification of crop cultivation has little impact on the production. The above fact suggests that agricultural production in Orissa is mainly an area lead growth.

The agricultural income in Orissa witnessed the second structural shift on 1992. There was major decline in the growth rate in between the period 1992-93 to 2005-06. Coinciding with

the structural break in the income series the area, yield and crop diversification index witnessed break points. Both index number of area and yield witnessed decline in the trend after the break point. Thus the decline in the growth rate of total income was primarily because of the negative growth in the area under cultivation and yield per hectare. The structural break in area, and yield index coincides with the structural break for total income in lag basis. There was decline and the negative growth rate for both area and yield in the state after 1990s that lead to the decline in the total income of the state. The downward structural changes in the income series was due to the decline in the area and yield. The crop diversification decreased in the state after 1990s which implies that the crop specialization increased in the state.

Section: VII Conclusion:

The two states, Andhra Pradesh and Orissa, witnessed two turn points or had three phases in income originating from agriculture. In others words, the two states did witness three growth regimes in the post independence period (1960-2005) but the break points are different. So, identifying phases in terms of policy changes at the economy level may provide biased estimates. In addition, the growth paths, over phases, of the two states are quite different. Andhra Pradesh witnessed a significant increase in rate of growth of income from agriculture in the first phase to the second phase while in the third phase there was only a marginal increase in the growth rate of income. Orissa, on the contrast witnessed a continuous decline in the rate of growth rate of income over the three phases.

The case of Andhra Pradesh, one finds the acceleration in the rate of growth of income originating from agriculture after the first break. The period after first break was accompanied with a break and acceleration in the index number of yield and increased diversification of crops in the economy. The index number of land also witnessed a break but there was a deceleration in the series. The acceleration in the growth from the second to the third phase was accompanied with an increase in crop diversification, but with no break in the index number of yield. During the shift from second to third phase, the index number of land witnessed a break but there was deceleration in the growth rate in the third phase as

compared to the second phase. The income originating from agriculture in Orissa witnessed a deceleration in the second phase when compared to the first phase. Even if the area and crop diversification witnessed increase in the growth rates but their impact on the aggregate income was negligible. This may be because the increase in area in Orissa led to the diversification towards the inferior crops. The shift from the second phase to the third phase in Orissa was accompanied with deceleration in the index number of area, yield and decline in the crop diversification. The state witnessed crop specialization in the third phase.

Appendix: 2 District-wise Distribution of Tribal Population in Orissa:

Share of Scheduled Tribes to the Total Population in 1961 and 2001 Census in Each Districts	
Districts	Share in 2001 census
Angul	11.67
Balasore	11.28
Bargarh	19.36
Bhadrak	1.88
Bolangir	20.63
Boudh	12.47
Cuttack	3.57
Deogarh	33.60
Dhankanal	12.79
Gajapati	50.78
Ganjam	2.88
Jagatsingghpur	0.82
Jaipur	7.76
Jharsuguda	31.34
Kalahandi	28.65
Khandamal	51.96
Kendrapada	0.52
Keonjhar	44.50
Khurda	5.18
Koraput	49.62
Malangiri	59.43
Mayurbhanj	56.60
Nabarangpur	55.03
Nayagarh	5.88
Huapara	34.71
Puri	0.30
Rayagada	55.76
Sambalpur	34.50
Subarnapur	9.78
Sundargarh	50.19
Orissa	22.13

Chapter: IV

Phase-wise Analysis of Growth Performance in Two States

Introduction:

The agricultural income in Andhra Pradesh and Orissa witnessed two structural breaks and three different phases. The factors accounting for structural break points in agricultural income were different from one state to another. The first break point in the agricultural income series was identified as yield led growth process for Andhra Pradesh whereas the second break point was generated due to the diversification of crop cultivation in the state. On the contrary, in Orissa area under cultivation and diversification were the factors that explained the first break point in the agricultural income series. The yield per hectare as a factor accounting for the first break point (in the so called green revolution era) in agricultural income witnessed no significant impact. The second break point in agricultural income (where the agricultural income declined) was the reflection of the decline in the area, yield index and increase in the crop specialization towards foodgrains in Orissa. So, the factors accounting for break points in two states and in each phase were different.

As the factors accounting for break points are different, thus by implication the sources for increasing/decreasing growth rate in agricultural income in each phase would be different from one another. Indian agriculture witnessed mainly three phases, the first phase continued till the mid sixties called as the extensive cultivation phase. The second phase witnessed intensive cultivation with introduction of green revolution whereas the third phase showed increase in the crop diversification (Rao 2004). Given the phases in Indian agriculture, in this chapter an attempt has been made to analyse whether the two states follow the similar path of growth process.

With the transformation from traditional to modern economy one can expect the change in the importance of the traditional inputs that affects growth rate to the modern technologies in agriculture. For example, the first phase in Indian agriculture was explained by the increase in use of traditional factors like expansion in area under cultivation by the land reform measures, introduced by the state. But the second phase which started after the introduction of green revolution witnessed the increase in the importance of modern technologies and

scientific methods. The third phase witnessed a shift in cultivation towards market oriented crops with private initiative into agriculture. Thus there is a shift in the importance from the traditional inputs towards the modern inputs and the factors that influenced the growth performance in each phase were different. As the sources for growth in each phase is different, the use of a single model for the analysis may not provide the changing importance of the factors affecting growth rate in each phase. In this context, the present chapter attempts to analyse the factors responsible for increase or decrease in the agricultural income growth rate for each phase and each state.

This chapter is divided into five sections. The first section reviews the literature on the changing importance of input in agriculture for different phases at all India level and at state level. The methodology of the study is presented in the second section. The changing importance of inputs in each phase and their growth performance in different phases in Andhra Pradesh and Orissa is being analysed in the third and fourth sections respectively. The last section presents the summary and the conclusion of the chapter.

Section: I Literature on Factors Affecting Agricultural Growth:

A larger number of research studies have been conducted on the factors influencing agricultural output or income growth rate in India [Dhawan (1995), Ramasamy (2004), Singh, Singh and Shrivastava (2005), Mathur, Das and Sircar (2006), Chand, Raju and Pandey (2007)]. There are some studies that analysed the sources of growth in agricultural income in different regions [Mishra (1983), Ranjan (1996), Reddy (1997), Singh, Raj and Karwasra (1997), Pattnaik, Nayak, Saluja (2004), Rath and Jena (2006)]. All most all the studies considered the period as a whole for analyzing the sources of output or income growth rate. There were limited studies that conducted the phase wise analysis [Mukhopadhyaya (1976), Kumar and Kaul (1991), Ranjan (1997), Ramasamy (2004)]. There is hardly any study, on the empirical analysis of the factors affecting agricultural income phase wise.

4.1.1 Whole Period Analysis:

The set of factors used in the past studies for the analysis of agricultural growth performances can be classified into three categories namely exogenous factors or traditional factors, modern technologies and crop diversification. Agricultural growth can be achieved either by expanding the land under cultivation, by increasing the capital use, by government intervention or by shifting from the traditional crop cultivation towards modern or commercial crops with a private initiative and state policy. An attempt has been made in this section to categorise the set of inputs used in literatures for different phases. It is difficult for a clear cut division of the factors into different categories as output is the combination of both modern and traditional variables.

Exogenous and Traditional Factors:

Studies by Singh, Singh and Shrivastava (2005), Gadgil and Gadgil (2006) and Chand, Raju and Pandey (2007) analysed the agricultural performances in India by including the exogenous factors like rainfall in the analysis and suggested that the growth rate depends on the amount of rainfall.

The foodgrain output growth pattern in India was calculated for the period 1971 to 1999 by considering a set of traditional and modern inputs (Singh, Singh and Shrivastava 2005). The factors that were considered in the study includes, seed (high yielding variety), fertilizer, irrigation, electricity, animated power (human and animal), mechanical power (tractor plus power tiller plus diesel engine plus electric motor) and rainfall in order to understand the cropping pattern in India. The result showed that rainfall was the defining factor, for the change in cropping pattern rather than the modern inputs. The cobb-douglas production function estimated for the analysis witnessed positive and significant coefficient for rainfall, irrigation and animate power. Consumption of fertilizer and mechanical power witnessed positive but insignificant coefficient where as electricity showed negative coefficient. The elasticity of production for rainfall was found to be positive and significant. Another study by Chand, Raju and Pandey (2007) used the amount of rainfall along with different modern inputs as the variables for the period from 1971-1972 to 2004-2005 to understand the factors

affecting gross domestic product from agriculture (GDPA) in India. The study suggested, rainfall as one of the most significant factors affecting GDPA. The decline in the growth rate of GDPA was studied with the help of regression analysis in three different models. In all the models, rainfall as an explanatory variable was positive and significant. One percent increase in rainfall resulted in positive and significant increase in the GDPA. The state level study by Rath and Jena (2006) also pointed out that the rainfall along with irrigation and net sown area are the principal determinants of agricultural growth in Orissa. The sources of growth in agricultural output in Orissa were measured by including amount of rainfall along with modern inputs like irrigation and seed fertilizer technologies. The states wise regression analysis shows that the coefficient of output with respect to the actual rainfall was significant for all the models. Apart from the amount of rainfall, the variability of rainfall also affects the agricultural output significantly. According to Mishra (1983) and Gadgil and Gadgil (2006), the magnitude of the negative impact of drought was more than that of positive impact of a surplus rainfall. The irregularity of rainfall caused either flood or drought in Orissa causing the low growth in the agricultural output (Mishra 1983).

Another exogenous factor that was identified in the literature is the economic structure of a particular state which affects the agricultural performances of the economy. According to Mishra (1983), one of the important factors responsible for poor agricultural performances in Orissa is the existence of higher percentage of SC and ST population in the state. The share of scheduled tribes and scheduled castes is account for about 40 percent of the total population in the state. They are economically weak and their market intervention is minimal. Another factor that affects the agricultural income is the small and marginal holding of land which accounts for about 75 percent of all operational holdings and controls less than 30 percent of total cultivated area in Orissa. The operational units are small and scattered in Orissa that led to low output growth in the economy.

Land under cultivation is also one of the important variable for the growth in the agricultural sector. Ramasamy (2004) discussed the constraint to agricultural growth in three periods i.e. 1970s, 1980s and 1990s in India. The study divided the factors affecting the agricultural growth output into technological constraint, resource constraint, and capital constraint. The

factors which caused technological constraint can be modern variety, agro-chemical use, mechanization and rainfed base. The analysis shows that the constitution of the technological change to agricultural production declined over the period. According to the study the decline in technology use in agriculture production has been attributed to dominance of land use in output production. The elasticity of output with respect to land, labour and credit shows that the elasticity of output with land was highest as compared to labour and credit.

The annual growth of foodgrain production in Bihar for the period from 1970 to 1993 was studied by Ranjan (1997). He suggested that land under cultivation was one among the prominent factor that affects production. The factor inputs included for the analysis combines both modern and traditional factors like gross crop area, irrigated area, fertilizer consumption, coverage under HYV seeds and annul rainfall. For the analysis, the whole state was divided into two zones according to their agro climatic conditions. Among all the factors, land under cultivation witnessed significant impact on agricultural production in the state. Irrigated area and rainfall influenced the agriculture production significantly in one zone and had non-significant positive influence in the other zone. Considering north Bihar as a whole, the result indicates that 68 percent of variation in foodgrain output was explained by the regression model. Regression coefficient of land, irrigation area and rainfall were positive where as regression coefficient of fertilizer and HYVs were found to be negative. This indicates the former variables have significant influence in the project area. Another study by Kumar and Kaul (1991) also tried to analyse the sources of output growth. The study considered inputs like area under cultivation, irrigation, fertilizer and area under HYV seeds to analyse their impact on growth in agriculture. The study reported that the coefficient of gross cropped area was positive and significant in all the models. The coefficient of gross irrigated area and fertilizer consumption were not found to be statistically significant during the period 1955-56 to 1989-90.

Irrigation and Modern Inputs:

The modern inputs include utilization of irrigation, use of high yielding varieties seed, fertilizer and electricity use into the agricultural field. A number of studies emphasized on the increase in the uses of modern inputs for the growth of output and income. According to Rao and Gulati (1994), the location specific technologies should increase in order to increase the production process.

The study by Mathur, Das and Sircar (2006) examined the growth in agricultural production and identifies factors that affect agricultural growth in the period from 1980 to 2003. The variables that were included in the study are total government expenditure, population growth, public and total investment, credit, electricity fertilizer usage, tractors, pump sets, rainfall and gross irrigated area. The bi-variate relationship of value of agricultural production with the factors shows that, partial elasticity of gross irrigated area was as high as 1.52 fallowed by fertilizer usages (0.72), number of pump sets (0.62) and usages of electricity (0.50) for agricultural purpose. The agricultural credit elasticity was 0.15 percent; that the government expenditure was 0.28, public investment was 0.29 and private investment was 0.24. The most crucial factors affecting agricultural performances in the country appeared to be public investment and support for fertilizer usage. Considering irrigation as a substitute for rainfall the results indicate that public investment in agriculture including irrigation, marketing, food processing and storage have significant impact on agricultural production in India. A similar study by Dhawan (1995) identifies the major factors contributing towards the high growth in some of the better performing states of India from 1968-69 to 1993-94. The study considered states, namely west Bengal, Haryana, Rajasthan, Tamil Nadu and Maharashtra, selected from five different regions of India. These states witness high growth of crop production. The characteristics of best productive states shows that use of inputs like irrigation, fertilizer, HYV seeds during the post-1981 period varied across regions. The fact also supported by Singh, Singh and Shrivastava (2005), implies that irrigation influences the food production more than proportionally.

The contribution of change in area and yield in agricultural growth was discussed by Vaidyanathan (2000). The average output per unit of area can be affected by change in

allocation of total area among crops as well as between different geographical units comprising the nation. The determinants of growth are area expansion, land use intensity, crop pattern change and increase in crop yield. Increase in the crop yield depends on irrigation, fertilizer use and seed variety with prices. Irrigation is an important factor affecting productivity of land. Inter regional variation in output per unit of cropped area bear a significant positive correlation with irrigation ratio. Change in rainfall- irrigation ratio, and fertilizer use shows that they have significant positive impact on the output. Within a particular rainfall zone the impact of fertilizer use and irrigation have significant positive association with yield change.

Singh, Raj and Karwasra (1997) studied the factors responsible for determining yield and acreage of important foodgrain crops across the states and country. This study considered thirteen major states of India. In order to measure the determinants of yield levels of important foodgrain, he fitted the multiple regression equation using the time series data from the period 1972-73 to 1992-93. Considering yield per hectare as the dependent variable, area irrigated (in thousand hectares), fertilizer consumption (in thousand tones), area under HYV and public sector investment into agriculture (in lakhs of rupees) are taken as the independent variables. At All India level fertilizer, HYV and public sector investment showed positive and significant result. Area irrigated showed negative but insignificant impact on yield. Among all variables fertilizer use was the most important factor exercising maximum influence on crop yields. The state wise analysis shows that irrigated area witnessed positive and significant impact in the case of rice and total foodgrain in Assam, Maharashtra and for wheat in Punjab and West Bengal. Thus increase in irrigation facilities in these states could further increase foodgrain production in the country. The regression coefficient of area under HYVs was positive and significant for total foodgrain in Andhra Pradesh, Gujarat, Rajasthan, Karnataka and Utter Pradesh. Similarly regression coefficient for fertilizer consumption was positive and significant in case of rice for Bihar, Tamil Nadu, Uttar Pradesh and West Bengal, and for total foodgrain in Bihar, Gujarat, Haryana, Rajasthan, Tamil Nadu and Uttar Pradesh. None of the coefficient of public investment in agriculture was found to be significant because of its sub-optimal use. The independent variables considered for finding the impact on the acreage of crop were irrigated area (000 ha), total cropped area (000 ha),

yield (kg/ha), road length (per 100 sq. km of area), number of regulated market and public investment in agriculture. The regression results suggest that yield (kg/ha) is the most influencing factor for acreage of foodgrain at All India level. Area irrigated and total cropped area show positive but insignificant result. The regression coefficient of number of regulated market and public investment shows negative and insignificant value.

Pattnaik, Nayak, Saluja (2004) studied performance of agricultural productivity in Orissa from the period 1985-86 to 1999-00 in a panel data analysis. The inputs were agricultural labour, irrigated area, area under high yielding variety, fertilizer consumption per hectare and rainfall. The estimation of Cobb-Douglas production function for all the 13 districts in Orissa showed positive coefficient for all variables. The labour coefficient was 0.15; it implies that if the labour input will increase by one percent the output per hectare will grow up by 0.15 percent. The coefficient of proportion of area irrigated was 0.06. This shows one percent increase in irrigated area per hectare, will result in 0.06 percent growth in the per hectare output. The proportion of area under HYVs results that one percent increase in HYVs leads to 0.07 percent increase in per hectare output. The coefficient of rainfall in month of June was 0.07. The coefficient of rainfall in month of October was negative and insignificant. The model suggests that taking 13 districts and 15 years , the agricultural productivity was highly influenced by HYVs, followed by labour, rainfall and irrigated area.

Reddy (1997) attempted to find the sources of growth in the paddy cultivation of Andhra Pradesh in the 1980s. An attempt has been made to find the sources of growth by regressing Total Factor Productivity (TFP) on some important variables. The result suggested that power and fuel were found to be important sources of growth of TFP in all zones and in all over Andhra Pradesh. The relative lower prices of modern inputs viz, fertilizer and tractors in comparison to those of traditional inputs (manures and bullock labour) which are partly due to subsidies given to modern inputs have enabled the farmers to substitute modern inputs for traditional inputs. This intern obtains higher yields at lower costs. The analysis also indicates that the farm size has no relationship with costs and productivity.

Singh, Singh and Shrivastava (2005) showed importance of infrastructure in the agricultural field. According to the study, production per hectare is directly related to machinery use. One

percent increase in animated power availability would increase more than proportionate increase in food production. For the entire farm business it was found that the mechanized farms operated more efficiently resulting in increasing returns to scale. Also Chand, Raju and Pandey (2007) pointed out that there should be increase in the power supply in the agricultural sector.

According to Ramasamy (2004), the lower growth in agricultural sector was mainly due to the capital constraint i.e. the investment in agriculture. The elasticity of government expenditure on agriculture indicates that one percent increase in government expenditure would lead to 5 percent increase in agricultural growth. This shows government expenditure and policies have vast impact on agricultural growth. Investment into agriculture (public or private) has a significant impact on the agricultural growth (Dev, 1998, Kalirajan and Shand 1997, Ghosh 1998, Rao and Gulati 1994). There was decline in the capital formation in agriculture. The total capital formation declined from 8.5 percent in 2000-01 to 6.5% in 2002-03 (Toor, Singh and Kaur, 2006). This decline was observed in case of private sector investment from 9.7% to 6.4% during above mention period.

4.1.2 Phase-wise Analysis:

Indian agriculture passed through different phases, thus the analysis of the sources of output growth for the whole phase may not provide the idea regarding the changing importance of inputs from one phase to another. There are few studies conducted on the phase wise analysis for understanding the sources of output growth.

The state wise analysis of crop yield in different periods shows that foodgrain production was high in between 1950-51 to 1964-65, in all sates except Utter Pradesh, Assam, and West Bengal. The reason for higher growth of production in the period was because pressure of population on land, increase in productivity on small holding, sizeable expansion of irrigation facility during the period. The factors which affected agricultural growth in the pre-HYV period were within the reach of a large section of agricultural population. The states showing significant growth in production, yield and area from 1950-51 to 1964-65 were Rajasthan,

Orissa, Kerala, Tamil Nadu, Bihar and Madhya Pradesh. The growth in the period, 1965-66 to 1979-80 was mainly due to increase in yield. Nearly 82 percent of growth in production during this period accounted for the improvement in yield per hectare. So in this phase factors influencing the improvement in yield were of critical importance. None of the first five states in the earlier period (1950-51 to 1964-65) could retain the same position in the phase from1965-66 to 1979-80. The state Orissa which occupied one of the top positions in the yield growth in the first period witness the last position in the yield growth in the second period. The most remarkable feature in 1965-66 to 1979-80 was an increase in share of purchased inputs for agricultural production. From the period 1970 to 1978 the purchased inputs in agriculture were growing at a faster rate 11% per annum at constant price. The two phases explained above are different from each other on the basis of contribution of yield in total output; they are not different from each other on the basis of growth rate of agricultural production. The decade 1980s witnessed a faster rate of growth in agricultural output compared to 1970s. During the course of development land as an input in agricultural production declined its dominance and the non-land inputs acquired greater importance. There was shift in the crop production from foodgrain cultivation towards the cash crops (Vyas 2003).

The study by Mukhopadhyaya (1976) estimated the total agricultural production function. The study included six inputs like area under cultivation, irrigated area, total fertilizer consumed, number of tractors, literate labours which was interpreted as an education variable and illiterate labour. The cobb-douglas production function has been constructed for the aggregate annual crop output in 72 districts in India for the period 1959-60 to 1968-69. The coefficient for the inputs of land, irrigation and tractor has statistically significant t-values. The t-statistics of education and labour are insignificant. If the quantities of these inputs are doubled, output is likely to increase by only about 41 percent. Decomposing the large residual into two components – regional effects and temporal effects- 95 percent of variance of the total distribution are attributed to the region effect. The region specific factors are widely divergent from district to district. This disparity might be due to the large difference in the quality of all the inputs as well as their climate, management efficient, land tenure

system, cultural practices with bearings on agricultural production, cumulative effects of past technology and investment.

Ranjan(1997), fitted a model for the period 1970-71 to 1981-82 and the period 1982-83 to 1993-94 to find the strength of dependent variable in increasing the agriculture production. The two period are, early and latter period of green revolution of north Bihar. The result shows that the regression coefficient of land was positive but not significant in the early period of green revolution but its regression coefficient was much higher (positive) and significant during latter period of green revolution. This shows inputs supply system and credit might have played major role in foodgrain production in early period of green revolution but land emerged as important factor in increasing agricultural production in latter phase of green revolution. The regression coefficient of rainfall was much higher and statistically significant during the early period of green revolution but it turned out as positive but not significant during latter period of green revolution. Regression coefficient of irrigated area and fertilizer were positive and HYVs was negative in both the period, but none of these coefficients were statistically significant.

The factors affecting agricultural growth for each phase and the whole period were studied by Ramasamy (2004). The period from 1970 to 1990 was divided into three phases like 1970s as phase one, 1980s as the phase two, and 1990s as the phase three. The study resulted that contribution of technological change to agriculture has declined over the period. Variables like cropped area, agricultural labour and institutional credit are considered under the technological change. The regression result suggests that in 1970s crop area was significant and positive while agricultural labour and institutional credit shows negative and insignificant result.

Kumar and Kaul (1991) did phase wise analysis to find the growth components in crop production in India. The whole period was divided into three phases. The first phase was pre green revolution period (1956-57 to 1966-67), the second phase was from 1966-67 to 1982-83. and the third phase was 1983-84 to 1989-90. The result suggests that in the pre green

revolution period land was the major component of crop output growth. The contribution in growth of agricultural output by gross cropped area, irrigation, fertilizer and area under HYVs were 72, 18 and 5 percent respectively during 1966-67 to 1982-83. It indicates that land is an important factor for agricultural growth in early green revolution period. During the post green revolution period, fertilizer was an important input of crop output growth (18%), where as HYVs and irrigated area could only register a marginal contribution of 5 percent each to growth in crop output during the post green revolution period.

All most all the past studies examined the sources of output growth for the whole period. There are few studies regarding the factors affecting agricultural growth in different phases. Among them very few studies used any statistical methods or the empirical analysis to examine the factors affecting growth in different phases.

Section: II **Methodology:**

The sources of break points were different from one phase to the other and in each state. Thus the nature of each phase is different which implies that the factors accounting for the growth rate in each phase would be different from one another. In this case, a single model may not help in explaining the factors influencing the growth in each phase. Thus the study emphasises on the phase-wise analysis of the changing importance of factors. Different models have been used for measuring the change in growth performance of inputs in each phase. The impact of the independent variables on the dependent variable in each phase is examined by taking multiple regression analysis by using ordinary least squares (OLS).

The general frame work of the model is:

$Y = c + \alpha X_1 + \beta X_2$

Where Y is the dependent variable, X_1 and X_2 are the Explanatory variables, c is the constant term and α, β are the coefficients of the independent variable. For all the models Y is agricultural income and X is the inputs.

The present study considered more than one model for each phase because the use of single model is not appropriate on econometric ground as it poses serious problem of multi-

collinearity. The modern inputs are correlated with each other in all phases. Once again, the number of observation in each phase is less, if one includes more variables the degree of freedom will be less. Thus in each model at most three variables are included. Since the regression is estimated in growth-rate form, the regression coefficients are output elasticity with respect to factor inputs. With a view to identify the important variables, the regression equations are estimated by taking the variables in all possible combinations. Some models show serious problem of autocorrelation which is overcome by including auto regressive term AR (1) as explanatory variable in all models. The significance of the coefficients is judged at three levels, viz. *: Significant at 1%; **: Significant at 5%; ***: Significant at 10%. The regression analysis was run with the actual data of the variables rather than percentage shares.

The inputs included here for analysis are divided into two categories: traditional inputs and modern inputs. The traditional inputs includes: (1) Rainfall: Data regarding rainfall covers the actual rainfall in the state during a particular year. (2) Land under cultivation [includes Gross Cropped Area (GCA), Net Sown Area (NSA) and Area Sown More than Once (ASMO)]. For the analysis, land under GCA, NSA and ASMO in the state is presented as a percentage of total geographical area. The modern inputs cover the variables like (1) Total net irrigated area in the state: Total net irrigated area is presented as a share of total net sown area in the state. Total net irrigated area again is divided into different sources like major and medium, flow, lift and other sources of irrigation. The composition structure of the irrigation sources are calculated as a percentage of total net irrigated area in the state. (2) Cropping pattern in the state: it includes the land under foodgrains, oilseeds, cash crops and other crops. Different type of crops cultivated is presented as a share of the total gross cropped area. (3) Modern inputs: like land under HYV seeds, total fertilizer consumption and electricity consumption in the state. For the analysis the area under HYV seeds as a percentage of total gross cropped area is presented. Per hectare consumption of fertilizer is calculated for each phase. The data regarding area under HYV seeds and fertilizer consumption is available from 1970-71 onwards; thus the analysis of the growth profile of modern inputs started from second phase onwards. The compound growth rate of the above

variables for each phase is presented from the actual data series and not from the share of the indicators.

Section: III Factors Influencing Growth Rate of Agricultural Income in Andhra Pradesh:

The present section makes an attempt to analyze the growth performances of different inputs, affecting agricultural income in Andhra Pradesh. The bi-variate relationship of the factor inputs with the agricultural income is also presented in this section. This represents the sources of growth in agricultural income for each phase in Andhra Pradesh and Orissa.

4.3.1 Factors Affecting Growth Rate of Agricultural Income in Andhra Pradesh in the First Phase (1960-61 to 1974-75):

The first phase for Andhra Pradesh ranged from 1960-61 to 1974-75. The compound growth rate of agricultural income in the first phase was 2.01%. In this phase, there was no significant expansion in the land under cultivation. The net sown area (NSA) as a share of the total geographical area increased from 39% in 1960-61 to 41% in 1974-75 (Table: 4.1). But the gross cropped area (GCA) as a percentage of total geographical area witnessed a significant increase from 43% in 1960-61 to 48% in 1974-75, which led to the corresponding increase in the area under double cropped[1] from 2.25% in 1960-61 to 6.52% in 1974-75. The growth rate of land under cultivation, in first phase illustrated positive (0.16%) but insignificant growth in the actual area under NSA (Table: 4.1). The compound growth rate of GCA (0.41%) and area under double cropping (2.34%) was positive and significant in this phase. Land under cultivation and provision of irrigation are complementary to each other. The net irrigated area did not show significant increase in this phase. The percentage of total net area irrigated to total net sown area was 26.98% at the starting of this phase and increased marginally to 29.12%[2] by the end of the phase with a compound growth rate of 0.40%.

[1] Area under double cropping calculated as the difference between total gross cropped area and net sown area.
[2] Out of the total proportion land irrigated in 1960-61 (26.98%), canal irrigation comprised 12% of NSA, tanks constituted 11% of NSA and well irrigation as a percentage NSA was 3%. The composition structure has changed towards the end of the phase, where the area irrigated by tank as a percentage to NSA has declined to

However, the composition of sources of irrigation showed marked change. There was a decline in the share of land irrigated by tank and other sources of irrigation and a corresponding increase in the share of area irrigated by canal and well irrigation. Tank as a traditional source of irrigation witnessed significant decline in the share towards the end of the first phase (from 39.67% in 1960-61 to 28.39% in 1974-75)[3]. A significant increase was observed in the percentage of area irrigated by wells (from 11.28% in 1960-61 to 20.76% in 1974-75) and percentage area irrigated by canal irrigation (from 45.75% in 1960-61 to 47.52% in 1974-75). Even if both the area under canal irrigation and well irrigation witnessed increase in trend, the rate of growth of the latter was higher than the former. The compound growth rate of actual area irrigated by well and canal irrigation was 1.21% and 4.07% respectively in the first phase. The significant increase in the area under well irrigation implied the increased use of electricity in the state. There was a significant increase in the consumption of electricity during the ending year of the phase. An increase in area under irrigation can result an increase in cultivated area, by shifting from dry cultivation to wet cultivation or increase in the double cropped area. The actual area under cultivation i.e. the net sown area did not show any significant increase in the trend. Thus the increase in the area under canal and well irrigation led to conversion of dry lands into wet lands. This has increased the double-cropped land in the state rather than actual expansion of area.

Table: 4.1 Growth Rate of Factors Affecting Agricultural Income in Andhra Pradesh in the First Phase (1960-61 to 1974-75):

Andhra Pradesh	**Growth Rate**	**Share in 1960-61**	**Share in 1974-75**	**Rate of Change#**	**Standard Dev@**

8% in 1974-75. On the contrary area irrigated by canal and well irrigation as proportion to NSA has increased to 13% and 6% respectively. This shows the marginal increase in the total net irrigated area in the first phase was primarily because of the expansion in the area under well irrigation.

[3] The share of area irrigated by canal, well and tanks are presented as a percentage of total net irrigated area.

Column	(1)	(2)	(3)	(4)	(5)
Rainfall	-	850	848	-0.23%	12.62
Gross Cropped Area	0.40 (2.21)	43.29	48.14	11.83%	1.52
Net Sown Area	0.16 (1.14)	39.51	41.88	6.01%	0.98
Area Sown more than Once	2.34 (3.25)	2.25	6.52	73.37%	2.05
Total Net Irrigated Area	0.23 (1.13)	26.98	29.12	7.94%	0.94
Area under Canal	1.21 (3.09)	45.75	47.52	3.86%	3.73
Area under Tank	-3.05 (-5.32)	39.57	28.39	-28.24%	5.70
Area under Well	4.07 (9.53)	11.28	20.76	83.69%	2.97
Area under Other Irrigation	-1.32 (-1.62)	3.40	3.22	-5.29%	0.55
Area under Foodgrain	-0.26 (-1.25)	77.39	71.94	-7.04%	2.33
Area under Oilseeds	3.33 (9.12)	12.89	16.94	40.85%	2.01
Area under Cash crops	1.01 (1.73)	3.83	5.01	31.41%	0.31
Area under Other Crop	0.20 (0.54)	5.98	6.27	4.85%	0.38
Electricity Consumption	17.98 (16.99)	82.00	580.00	607.25%	190.66

Note: The Column: 1 presents the growth rate of the factor inputs which is calculated from the actual data.
Numbers in the brackets are the t-statistics value.
Column 2 and 3 includes the percentage share of the variables at the staring and the ending year of the first phase.
GCA/NSA/ASMO = Presented as a percentage to total Geographical Area in Andhra Pradesh.
Canal /Tank /Well /Others = Represents the share of area irrigated by Canal/ Tank/ well to total Net Irrigated Area.
Area under Food Crop/ Oilseeds/ Cash Crops / Other = Presented as a Percentage to Gross Cropped Area.
Rainfall includes the total amount of rainfall in the starting and the ending year of the first phase.
Electricity Consumption – represents the total electricity consumption in the state.
Rate of change of factors, calculated as [(value in last year- value in first year)/value in first year * 100].
@ Standard deviation of the share of the variables is presented in the table except for Rainfall and electricity consumption.

Source: Statistical Abstract of Andhra Pradesh, various issues.

With the increase in the irrigation facility and cropping intensity, there should be a change in type of crop cultivated[4]. The types of crop cultivated are classified into foodgrains, oilseeds, cash crops and other crops. Among the four categories, only the area under oilseeds witnessed positive and significant growth rate (3.33%), whereas area under cash crops (1.01%) and other crops (0.20%) showed positive but insignificant growth rate (Table: 4.1). Total area under foodgrain as a share of GCA was 77% in 1960-61 and it declined to 70% in 1974-75. Among the foodgrains, the area under rice witnessed increase from 25.06% in 1960-61 to 30.05% in 1974-75. Area under maize as a percentage of gross cropped area was

[4] Rainfall and irrigation has bearing on the type of crop which can be grown in a region (vaidyanathan 2000). Change in the cropping pattern witness shift of cultivation from tradition crops or low value crops to modern or high value crops.

1.54% in 1960-61, increased marginally to 2.49% in 1974-75 and the area under pulses was 10.58%, in 1960-61 and increased to 11.17% in 1974-75 (the data regarding the share of some important crops to the total GCA is presented in the table: 4.2). The compound growth rate of area under rice was positive but insignificant whereas the growth rate of area under maize and pulses was positive and significant. The types of cereals, witnessed decline in share are jowar (from 23.10% to 17.21%), bajra (from 2.53% to 4.74%) and ragi (from 3.12% to 2.74%). Total area under oilseeds was 12.89% in 1960-61 which increased to 16.94% in 1974-75. In 1960-61, out of the total percentage area under oilseeds and groundnuts alone covered 6.79% and increased to 11.07% in 1974-75. Area covered by castor and sesamum was 2.52% and 1.71% respectively in 1960-61. The percentage area under castor increased marginally to 3.34% whereas the percentage area under sesamum remained stagnant with 1.71% in 1974-75. Total area under cash crops includes cotton, tobacco, chillies and sugarcane. There was total 3.83% of area covered by cash crops in Andhra Pradesh in 1960-61; the share increased to 5.12% in 1974-75. The growth rate of total area under cash crops shows positive but insignificant growth. Thus, the increase in the area under double cropping was due to an increase in the area under cotton, groundnuts and paddy. This shows that the cropping pattern in the first phase witnessed decline in area under foodgrains and increase in area under oilseeds and cash crops. Thus, the first phase shows a diversification from area cultivated under foodgrains towards Oilseeds and Cash crops. But among foodgrains, there was a shift from inferior cereals like jowar, bajra towards rice and pulses.

Table: **4**.**2** Cropping Pattern in Andhra Pradesh in the First Phase (1960-61 to 1974-75):

Andhra Pradesh	Phase-I	
	Share of Crops in 1960-61	Share of Crops in 1974-75

Area under Foodgrains	**77.39**	**71.94**
Area under paddy	25.06	30.05
Area under Jowar	23.10	17.21
Area under Ragi	3.12	2.74
Area under Bajra	5.23	4.74
Area under maiza	1.54	2.49
Area under Pulses	10.58	11.17
Area under Oilseeds	**12.89**	**16.94**
Area under Groundnut	6.79	11.07
Area under Castor	2.52	3.34
Area under Cash crops	**3.83**	**5.12**
Area under Cotton	2.80	3.12
Area under Chilies	1.03	1.26
Area under Other Crops	**4.96**	**4.94**

Note: The areas under the crops cultivated are presented as a share of Gross Cropped Area.
Source: Statistical Abstract of Andhra Pradesh, various issues.

The growth rate of the factors affecting agricultural income in Andhra Pradesh shows an increasing trend in all the variables for first phase except irrigation through tank and area cultivated under foodgrains. Extensively higher growth rate was observed in the case of area under oilseeds and area irrigated by well irrigation. There was an increase in the area under double cropping compared to the actual area under cultivation. The public provision of irrigation in terms of canal irrigation increased and there was diversification of crop cultivation towards oilseeds. This phase also witnessed shift from inferior cereals towards superior cereals like rice and pulses.

The impact of inputs on agricultural income is measured with the help of the regression analysis. The study considered four different models for measuring the impact of different inputs on the income from agriculture in the first phase. Four different models have been used to avoid the multi-collinearity problem as some of the variables are correlated with each other. The correlation matrix is presented in the table: 4.3. Area under irrigation and land under cultivation i.e. GCA, NSA and ASMO move in a similar direction showing high correlation among them. Net area under cultivation, total area under irrigation and area under rice are correlated with each other. Area under oilseeds is correlated with both area under well irrigation and canal irrigation. Rainfall (the exogenous factor) is highly correlated with area under foodgrains (0.92), implying the fact that in the first phase, the increase in the area under foodgrains depended on the amount of rainfall.

Table: 4.3 Correlation Matrix of Agricultural Inputs in Andhra Pradesh in the First Phase (1960-61 to 1974-75):

	GCA	NSA	ASMO	IRRI	CANAL	TANK	WELL	FOOD	RICE	OIL	CASH	RAIN
GCA	1											
NSA	**0.91**	1										
ASMO	**0.86**	0.56	1									
IRRI	**0.82**	**0.89**	0.51	1								
CANAL	0.61	0.37	0.74	0.44	1							
TANK	0.02	0.29	-0.32	0.31	-0.63	1						
WELL	0.51	0.33	0.60	0.41	0.74	-0.65	1					
FOOD	0.57	0.63	0.34	0.55	-0.10	0.58	-0.24	1				
RICE	0.78	**0.88**	0.47	**0.89**	0.14	0.59	0.09	0.77	1			
OILSEED	0.55	0.39	0.60	0.40	**0.82**	-0.57	**0.82**	-0.36	0.12	1		
CASH	0.71	0.65	0.61	0.63	0.56	-0.05	0.41	0.29	0.51	0.46	1	
RAIN	0.45	0.61	0.15	0.48	-0.21	0.62	-0.32	**0.92**	0.69	-0.41	0.13	1

Note: NSA – represents Net Sown Area, GCA – represents Gross Cropped Area, ASMO – represents area sown more than once. IRRI- represents here as area under total irrigation. HYVs – represents area under HYVs seeds. FER – represents total fertilizer consumption. FOOD/RICE/OIL/CASH – represents area under foodgrains, rice, oilseeds and cash crops respectively.

The explanatory variables in the first model for phase one are area under double cropping, total area irrigated and area under foodgrains. Net irrigated area and net sown area are highly correlated with each other (0.89). Thus, the model considered area under double cropping as an indicator of the land use pattern in the state (area under double cropping also witnessed increasing trend in the phase). After the inclusion of first order lagged residual term, i.e. AR (1) specification, the estimated Durbin-Watson value shows that there was no negative serial correlation at 5% level of significance. Since the regression is estimated in growth-rate form, the regression coefficients are output elasticities with respect to factor inputs. The result shows that the area under irrigation and area under double cropping has a positive and significant impact on the net income from agriculture. The estimated coefficient of income from agriculture with respect to area sown more than once and total area under irrigation was 0.52 and 1.14 respectively (Table: 4.4). It implies that 10% increase in either the area sown more than once and irrigation facility would lead to 5.2% and 11.4% increase in the net income from agriculture respectively in the initial phase.

The second model considered the independent variables like area under double cropping, area irrigated by wells and area under paddy cultivation for the analysis. In order to analyse the impact of sources of irrigation on income originating from agriculture, the area under

well irrigation instead of area under total irrigation is considered as an explanatory variable. The reason behind considering the area under paddy as an explanatory variable is because it constitutes the major share of area under foodgrains and moreover there was increase in the area under paddy in the phase. The result shows that both area irrigated by well irrigation and area under rice have a significant impact on income. Area under well irrigation is significant at 1% level but area under rice was significant at 10% level. Thus, the impact of increase in area under well irrigation is more significant than the increase in area under paddy on agricultural income. The estimated coefficient of agricultural income with respect to well irrigation and area under paddy was 0.51 and 0.67 respectively (Table: 4.4). It implies that with 10% increase in any of the above variables, the income will increase by 5.1% and 6.7% respectively in the first phase.

Table: 4.4 The Estimated Effects of Factors Affecting Agricultural Income in First Phase:

Andhra Pradesh	**Phase-I (1960-61 to 1974-75)**			
	Model-I	Model-II	Model-III	Model-IV
C	12.79 (1.96) (0.08)	4.46 (3.71) (0.00)	-9.87 (-1.60) (0.14)	-3.65 (-1.09) (0.29)
Gross Cropped Area			**3.74 **** (2.28) (0.05)	
Area Sown More than once	**0.52**** (2.41) (0.04)	0.17 (0.34) (0.89)		0.22 (1.40) (0.18)
Net Irrigated Area	**1.14 **** (2.40) (0.04)			**1.71*** (3.24) (0.007)
Area under Well Irrigation		**0.51*** (3.42) (0.01)	0.24 (1.00) (0.34)	
Area under Foodgrains	-1.55 (-1.59) (0.15)		-1.96 (-1.34) (0.21)	
Area under Rice		**0.67***** (1.98) (0.08)		
Amount of Rainfall				**-0.37 **** (-2.19) (0.05)
Ar (1)	0.64 (2.35) (0.04)	0.14 (0.44) (0.67)	0.58 (2.30) (0.05)	
R2	0.76	0.70	0.74	0.69
DW	1.92	1.87	1.73	1.85
F	6.96	5.15	6.40	5.27

Notes: The first value in the parenthesis indicates the t-statistics values.
The second value in the parenthesis indicates the Probability values.
* = Significant at 1%; ** = Significant at 5%. *** = Significant at 10%.

The explanatory variables for the third model are GCA, area irrigated by well irrigation and area under foodgrains. Area under total net irrigated area and total gross cropped area are correlated with each other (0.82), thus the model considered area under well irrigation instead of total irrigated area as an indicator of the amount of irrigation in the state. The result shows that GCA has significant impact on the income from agriculture. The estimated

coefficient of agricultural income with respect to GCA was 3.74. This implies that for every 10% increase GCA, the agricultural income would increase by 37.4%. The same model is also tested by considering area under paddy with GCA and area under well irrigation. The result was similar as the impact of gross cropped area was positive and significant.

The last model considered the exogenous factors like rainfall, along with area under double cropping and total area under irrigation. Amount of rainfall witnessed multi-collinearity with land under foodgrains (0.92). In order to avoid the problem this model considered area under rice as proxy of cropping pattern. But, total irrigated land and area under rice are highly correlated (0.89) and also total land irrigated and GCA is correlated (0.82). Thus to avoid the problem of multi-collinearity, the model considered the amount of rainfall, area sown more than once and net irrigated area as independent variables. The result shows that total land irrigated is positively and significantly correlated with income from agriculture. The coefficient of income from agriculture with respect to irrigation was 1.71, implying that when there is 10% increase in the area under irrigation; income from agriculture would increase by 17.1%. Amount of rainfall showed negative and significant impact on income from agriculture in the first phase. The coefficient of income from agriculture with respect to rainfall was -0.37 and significant at 5% level of significance. This shows that with the increase in the rainfall by 10%, income will decline by 3.7%.

Both growth rates and regression analysis of factors affecting agricultural income implies that, the first phase in Andhra Pradesh can be termed as a phase of intensive cultivation; where with the increase in the canal and well irrigation there was increase in the cropping intensity (it shows the number of times a piece of land is cultivated). It denotes that there was substitution of dry land into wet lands by cultivating the area more than once. The expansion of actual area under cultivation was limited. There was also diversification of foodgrains towards oilseeds. However, the percentage area covered by foodgrains was higher compared to any of crop categories. Among the foodgrains, the area under rice increased but area under other cereals declined. Thus, the impact of GCA and area sown more than once witnessed positive and significant impact on agricultural income along with increase in irrigation through wells.

4.3.2 Factors Affecting Growth Rate of Agricultural Income in Andhra Pradesh in the Second Phase (1975-76 to 1988-89):

The second phase for Andhra Pradesh ranged from 1975-76 to 1988-89. The growth rate of agricultural income accelerated to 2.76% in the second phase compared to 2.01% in the first phase. This period approximately coincides with the phase of green revolution. The agrarian policy regime during this phase was the provision of subsidized inputs to farmers and price control for the agrarian output. Correspondingly, the area under HYV seeds and consumption of fertilizers witnessed an increase in trend.

In this phase, the green revolution package was introduced. The area under HYVs and consumption of fertilizers witnessed positive (3.36% and 9.45% respectively) and significant growth rate (Table: 4.5). Per hectare consumption of fertilizer witnessed a sharp increasing trend in the phase. The consumption of fertilizer per hectare was 25.23 kg per hectare; it increased to 108 kg per hectare by the end of the phase[5]. Percentage area under HYV seeds to GCA was 30.26% in 1975-76 and the share increased to 53.07% by 1988-89. The area under HYV seeds can increase either by bringing more area under cultivation or by converting the dry lands into wet with increase in irrigation or by shifting from traditional crops to HYV crops.

The total land under cultivation did not witness increase in the trend. The percentage area under GCA was 47.93% in 1975-76, the share declined marginally to the level of 47.22% in 1988-89. The percentage net sown area in the state shows a declining trend (from 40.71% in 1975-76 to 40.01% in 1988-89). The period from 1984-85 to 1987-88 witnessed a major decline in the net sown area. The growth rate of percentage net sown area was negative (-0.33%) and insignificant. Even if there was decline in both gross cropped area and the net sown area, the decline in the area under NSA was faster than the decline in the area under GCA. Thus there was insignificant increase in the area under double cropping in the state

[5] Consumption of fertilizer in Andhra Pradesh is more than the national average (Rao, Acharya, Swaminathan 1998).

(from 6.51 1975-76 to 7.80% 1988-89). The growth rate of area under double cropping was positive (1.13%) and insignificant. It implies that in this phase there was no expansion in the area under cultivation.

Table: 4.5 Growth Rates of Factors Affecting Agricultural Income in Andhra Pradesh in the Second Phase (1975-76 to 1988-89):

Andhra Pradesh	**Growth Rate**	**Share in 1975-76**	**Share in 1988-89**	**Rate of Change#**	**Standard Dev@**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Rainfall	-	1104	1144	3.62%	146.21
Gross Cropped Area	-0.11 (-0.39)	47.93	47.22	1.49%	1.87
Net Sown Area	-0.33 (-1.35)	40.71	40.01	-1.44%	1.46
Area Sown more than Once	1.31 (1.80)	6.51	7.80	2.97%	1.89
Total Net Irrigated Area	0.78 (1.89)	30.76	38.65	25.64%	2.11
Area under Canal	0.005 (0.02)	47.31	43.91	-7.17%	2.06
Area under Tank	-2.66 (-3.57)	32.00	25.94	-18.95%	4.06
Area under Well	3.20 (7.68)	16.99	26.62	56.67%	3.25
Area under Other Sources	-3.42 (-0.68)	3.66	3.52	-3.86%	1.02
Area under Foodgrains	-1.71 (-5.52)	75.78	63.07	-19.48%	4.69
Area under Oilseeds	4.35 (9.25)	13.57	22.96	69.21%	3.10
Area under Cash Crops	4.62 (7.05)	4.10	6.33	99.41%	0.99
Other Crops	1.88 (5.04)	4.96	7.07	33.22%	0.69
Fertilizer Consumption	9.45 (10.98)	25.23	108.00	328.13%	22.60
Area under HYVs seeds	3.36 (10.22)	30.26	53.07	75.40%	8.57
Electricity consumption	16.81 (13.14)	726.00	4629.58	537.68%	159.25

Note: The Column: 1 presents the growth rate of the factor inputs which is calculated from the actual data.
Numbers in the brackets are the t-statistics value.
Column 2 and 3 includes the percentage share of the variables at the staring and the ending year of the first phase.
GCA/NSA/ASMO = Presented as a percentage to total Geographical Area in Andhra Pradesh.
Canal /Tank /Well /Others = Represents the Percentage of area irrigated by Canal/ Tank/ well to total Net Irrigated Area.
Area under Food Crop/ Oilseeds/ Cash Crops / Other = Presented as a Percentage to Gross Cropped Area.
Rainfall includes the total amount of rainfall in the starting and the ending year of the first phase.
Fertilizer consumption shows the per hectare consumption of fertilizer.
Area under HYVs seeds – percentage to total GCA
Electricity Consumption – represents the total electricity consumption in the state.
Rate of change of factors, calculated as [(value in last year- value in first year)/value in first year * 100].
@ Standard deviation of the share of the variables is presented in the table except for Rainfall and electricity consumption.

Source: Statistical Abstract of Andhra Pradesh, various issues.

The second phase did witness a higher growth in the land under irrigation when compared to the first phase. Net area irrigated as a percentage to total net sown area in Andhra Pradesh witnessed smooth upward trend in the second phase. In the beginning of the phase, the

percentage area under irrigation was 30.76% and it increased to 38.65% towards the end of the phase[6]. The net area irrigated witnessed positive (0.78%) and significant growth in the phase. The expansion in the net irrigated area was primarily due to the positive and significant growth in the area under well irrigation (3.20%). Total, 16.99% area was irrigated by wells in 1975-76 and it increased to 26.62% in 1988-89. The area covered by canals was 47.31% and it declined marginally to 43.91% at the end of the phase. Thus the growth rate was insignificant (0.005%) in the phase. There was momentous decline in the area irrigated by tanks from 32% in 1975-76 to 25.93% in 1988-89. The area irrigated by tanks witnessed significant negative growth rate (-2.66%) in the phase. This shows that the percentage area under canal and tank declined, whereas the percentage land irrigated by wells increased.

The cropping pattern in the state witnessed a shift towards oilseeds and cash crops and a decline in the area under foodgrains. The share of area under foodgrains to total gross cropped area was 75.78% in 1975-76 and it declined to 63.07% in 1988-89 (Table: 4.6). However, the composition structure in the foodgrains shows that there was increase in the share of area under rice (from 29.22% in 1975-76 to 30.76% in 1988-89) and pulses (10.39% in 1975-76 to 17.58% in 1988-89) to the total gross cropped area. The area under jowar (from 18.42% in 1975-76 to 9.02% in 1988-89), bajra (4.53% in 1975-76 to 1.75%), ragi (from 2.62% in 1975-76 to 1.24% in 1988-89), maize (2.43% in 1975-76 to 2.34% in 1988-89) and other cereals (8% to 3%) declined significantly as a share of total area under gross cropped. Share of total area under foodgrains declined and among the foodgrains area under rice increased marginally whereas the area under inferior cereals reduced. The crops that picked up due to the decline in the area under foodgrains were groundnuts, castor, cotton and chillies. Total area under oilseeds covered around 23% of gross cropped area in 1988-89 when compared to 13.57 in 1975-76. There was increase in the area under cash crops from 4.10% in 1975-76 to 6.33% in 1988-89; but the area covered under cash crops was low compared to the share of area covered by food crops and oilseeds. The growth rate of area

[6] Out of the total irrigated area (30.76%) in 1975-76, canal covers 14.56%, tank covers 9.85% and well irrigation covers 5.23% as a share of total net sown area. The share of total land irrigated as a percentage to net sown area has increased to 38.65% at the end of the second phase. Out of percentage of total net irrigated area canal covers 16.97%, tank covers 10.03% and well covers 10.29% as a percentage to total net sown area in 1988-89.

under cash crops was 4.62% in the phase. This shows that in the second phase there was diversification towards oilseeds and cash crops cultivation in the state.

Table: **4.6** Cropping Pattern in Andhra Pradesh in the Second Phase (1975-76 to 1988-89):

Andhra Pradesh	**Phase-II**	
	Share of Crops in 1975-76	Share of Crops in 1988-89
Area under Foodgrains	**75.78**	**63.07**
Area under paddy	29.22	30.76
Area under Jowar	18.42	9.02
Area under Ragi	2.62	1.24
Area under Bajra	4.53	1.75
Area under maiza	2.43	2.34
Area under Pulses	10.39	12.37
Area under Oilseeds	**13.57**	**22.96**
Area under Groundnut	10.26	17.58
Area under Castor	2.10	3.34
Area under Cash crops	**4.10**	**6.33**
Area under Cotton	2.01	4.78
Area under Chilies	1.17	1.55
Area under Other Crops	**4.96**	**7.07**

Note: The areas under the crops cultivated are presented as a share of Gross Cropped Area.
Source: Statistical Abstract of Andhra Pradesh various issues.

The above analysis suggests that the land under cultivation hardly showed any increase in area in the second phase**.** Both the GCA and NSA remained relatively stagnant in this phase. Percentage of area irrigated in the phase increased significantly due to the increase in the area under well irrigation. The uses of modern inputs into agriculture witnessed positive growth rate. The cropping pattern witnessed a decline in the percentage of area under foodgrains and increase in area under oilseeds and cash crops. Thus the implementation of modern inputs led to increase in irrigation sources and diversification towards oilseeds and cash crops, whereas among foodgrains there was shift from inferior cereals towards rice. The decline in the land under cultivation was substituted by the increase in modern technology that in-turn led to a significant increase in the growth rate of agricultural income.

A regression analysis on factors contributing to agricultural performance is presented in table 4.7. To avoid the problems of multi-collinearity among modern inputs and irrigation, different models were used in the analysis. The set of explanatory variable used for the analysis of factors affecting agricultural income in the second phase are GCA, total irrigated

area, different sources of irrigation, fertilizer used, area under HYV seeds, area under foodgrains and area under rice. Five different models are used to analyse the impact of inputs on agricultural income in Andhra Pradesh. The modern inputs like HYV seeds, fertilizer and electricity are correlated with each other. To avoid the multi-collinearity problem different models were considered. Fertilizer used and area under HYV seeds were highly correlated with each other (0.92). In order to avoid the problem, each model considered only one modern input at a time. Area under well irrigation, area under oilseeds and cash crops were correlated with area under HYVs and fertilizer consumption in the state. Area under paddy cultivation was found to be correlated with traditional inputs like land under cultivation and tank irrigation.

Table: 4.7 Correlation Matrix of Agricultural Inputs in the Second Phase (1975-76 to 1988-89):

	NSA	ASMO	GCA	IRRI	CANAL	WELL	TANK	HYV	FER	FOOD	Rice	OIL	CASH	RAIN
NSA	1													
ASMO	0.44	1												
GCA	**0.94**	0.71	1											
IRRI	0.44	0.71	0.60	1										
CANAL	0.12	0.63	0.32	0.78	1									
WELL	-0.20	0.58	0.06	0.61	0.60	1								
TANK	0.77	0.20	0.68	0.56	0.13	-0.27	1							
HYV	-0.19	0.64	0.09	0.60	0.77	0.81	-0.27	1						
FER	-0.16	0.64	0.11	0.70	0.74	**0.96**	-0.18	**0.92**	1					
FOOD	0.77	-0.01	0.60	-0.08	-0.31	-0.74	0.68	-0.69	-0.70	1				
Rice	**0.83**	0.68	**0.90**	0.79	0.43	0.13	**0.84**	0.14	0.22	0.50	1			
OIL	-0.11	0.67	0.16	0.65	0.62	**0.95**	-0.18	**0.92**	**0.95**	-0.68	0.22	1		
CASH	-0.22	0.51	0.02	0.47	0.63	**0.88**	-0.39	**0.84**	**0.88**	-0.74	-0.02	0.85	1	
RAIN	0.64	0.38	0.64	0.62	0.11	0.04	**0.82**	0.03	0.09	0.40	**0.83**	0.17	-0.15	1

Note: GCA – represents Gross Cropped Area, NSA – represents Net Sown Area, ASMO – represents area sown more than once. IRRI- represents here as area under total irrigation. HYVs – represents area under HYVs seeds. FER – represents total fertilizer consumption. FOOD/RICE/OIL/CASH – represents area under foodgrains, rice, oilseeds and cash crops respectively.

The explanatory variables for the first model are area sown more than once, area under paddy and area under HYV seeds. The area under HYV seeds represents one among the modern inputs and area under double cropping represents the land use pattern in the state. The result shows that the effect of area under HYV seeds on agricultural income was positive and significant. The coefficient of agricultural income with respect to area under HYV seeds was 0.68, which is significant at 1% level. It implies that with 10% increase in the area under

HYV seeds in Andhra Pradesh the income would increase by 6.8%. The effect of area under double cropping and area under rice was positive but insignificant. This shows that the impact of the traditional inputs declined with the introduction of the modern inputs.

The second model considered the total area irrigated, area under rice and area under HYV seeds[7]. The area under rice, GCA (0.90) and NSA (0.83) were highly correlated. Out of the total irrigated area, irrigation by wells witnessed a positive trend in the phase. Nevertheless, the area irrigated by wells had multi-collinearity with area under HYV seeds. Thus, the model considered the total area irrigated.

Table: 4. 8 The Estimated Effects of Factors Affecting Agricultural Income in Second Phase:

Andhra Pradesh	**Phase-II (1975-76 to 1988-89)**				
	Model-I	Model-II	Model-III	Model-IV	Model-V
C	0.22 (0.16) (0.87)	1.62 (0.49) (0.63)	-8.89 (-2.42) (0.04)	0.62 (0.16) (0.88)	-0.94 (-0.22) (0.83)
Area Sown More than Once	0.32 (1.02) (0.33)			**0.57**** (2.60) (0.03)	
Net Irrigated Area		0.35 (0.45) (0.66)			0.17 (0.29) (0.78)
Area under Canal Irrigation				0.46 (0.75) (0.47)	
Area under Well Irrigation			**0.46***** (1.87) (0.09)		
Area under Foodgrains			**0.98**** (3.21) (0.01)		0.70 (1.28) (0.23)
Area under paddy	0.30 (0.76) (0.46)	0.85 (1.39) (1.19)			
Area under HYVs Seeds	**0.68*** (3.37) (0.007)	**0.92 **** (4.04) (0.00)	**0.78**** (2.96) (0.01)		
Fertilizer Consumption				**0.16**** (2.12) (0.06)	**0.39**** (2.67) (0.02)
R2	0.83	0.82	0.87	0.82	0.75
DW	1.72	1.98	2.09	1.72	1.76
F	16.72	15.20	22.44	15.23	9.73

Note: The first value in the parenthesis indicates the t-statistics values.
The second value in the parenthesis indicates the Probability values.
* = Significant at 1%; ** = Significant at 5%. *** = Significant at 10%.

The independent variables in the third model are area irrigated by wells, area under foodgrains and area under HYV seeds. Area under well irrigation found to be highly correlated with area under oilseeds and cash crops; thus the area under foodgrains was considered as a proxy for the cropping pattern in the state. All the three variables witnessed positive and significant impact on income from agriculture. The coefficient of income from

[7] Actual land under cultivation and area under double cropping were dropped in the second model as the effect of those factors is not significant.

agriculture with respect to area under foodgrains and area under HYV seeds was found to be significant at 5% level. But coefficient of income from agriculture with respect to area under well irrigation was significant at 10% level. The coefficient of income originating from agriculture with respect to area under wells, area under foodgrains and area under HYV seeds were 0.46, 0.98 and 0.78 respectively. This implies that 10% increase in any of the above variables would increase the income by 4.6%, 9.8% and 7.8% respectively.

The fourth model considered fertilizer consumption, area sown more than once and area irrigated by canals as the explanatory variables. Area irrigated by wells and fertilizer consumption were found to be highly correlated (0.96). The amount of fertilizer consumed was also highly correlated with area under HYV seeds, area under oilseeds and cash crops. In order to avoid the problem of multi- collinearity, the fertilizer consumption (as a proxy of modern inputs), area under canal irrigation (as a source of irrigation facility) and area under double cropping (as a traditional factor) were considered. The result shows that area under double cropping and consumption of fertilizers witnessed positive and significant impact on income from agriculture. The coefficient of income from agriculture with respect to area under double cropping and fertilizer consumption was 0.57 and 0.16 respectively, implying that with 10% increase in any of the variable, the income would increase less than proportionately at 5.7% and 1.6% respectively. The effect of canal irrigation on income from agriculture was positive but insignificant in the phase.

The independent variables in the last model were total area under irrigation, area under foodgrains and consumption of fertilizers. The result shows only consumption of fertilizer had a significant impact on income from agriculture. The coefficient of income from agriculture with respect to consumption of fertilizers was 0.39. Thus with 10% increase in the fertilizer consumption, the income would increase by 3.9%. The effect of total area under irrigation and area under foodgrains on agricultural income was positive but insignificant.

The above analysis of the importance of the factor inputs on income from agriculture illustrated the fact that there was substitution of modern inputs for traditional inputs in the phase. The land based growth system did not prevail anymore in the second phase. Land as

an input for agricultural income was not significant; there was only an insignificant shift in the dry lands to wet land cultivation. With the provision of irrigation there was a minute increase in area under double cropping. Among the modern inputs, area under HYV seeds witnessed more significant impact than the fertilizer consumption, implying the fact that there was public investment in agriculture. Government plays an important role in the provision of modern inputs. Thus, the phase in Andhra Pradesh can be explained as modern inputs led growth process with government intervention. The phase also witnessed diversification of area under foodgrains towards oilseeds and cash crops.

4.3.3 Factors Affecting Growth Rate of Agricultural Income in Andhra Pradesh in the Third Phase (1989-90 to 2005-06):

The third phase in Andhra Pradesh extends from 1989-90 to 2005-06. There was a marginal increase in the growth rate of income from 2.76% in second phase to 2.80% in the third phase. In this phase, the cropping pattern witnessed a decline in the area under foodgrains from 60.89% in 1989-90 to 51.77% by 2005-06 (Table: 4.9). The percentage area under oilseeds was 23.93% in 1989-90, and after 1990-91 the share of the land under oilseeds has declined until 2003-04 (from 25.75% to 21.54%). Since then, there was an increase in share to 25.21% in 2005-06. There was a major increase in the share of land under cash crops from 9.68% in 1989-90 to 15.56% in 2005-06. It implies that there was diversification of crop cultivation towards cash crops from foodgrains and oilseeds. The area under cash crops illustrated a momentous increase due to the significant increase in the area under cotton and tobacco. The percentage of area under cotton was 4.90% in 1988-89; it increased to 10.94% in 2005-06. Among the foodgrains there was a decline in the area under rice (from 29.84% in 1989-90 to 25.81% in 2005-06) and other inferior cereals. Pulses is the only foodgrain which witnessed increase in area; its share being 12.47% at the staring of the phase increased to 14.89% by the end of the phase. The phase witnessed decline in the share of GCA (from 48.32% to 45.63%) and NSA (from 40.43% to 37.65%) in the state and correspondingly the cropping intensity did not show much change in the phase (from 7.78 to 7.98%). The growth rate of NSA in the state for third phase was negative and significant (-0.41%). It shows the

land under cultivation declined and there was substitution of area under foodgrains and oilseeds towards cash crops.

Table: **4.9** Cropping Pattern in Andhra Pradesh in the Third Phase (1989-90 to 2005-06):

Andhra Pradesh	Phase-III (1989-90 to 2005-06)	
	Share of Crops in 1989-90	Share of Crops in 2005-06
Area under Foodgrains	**60.89**	**51.77**
Area under paddy	29.84	25.81
Area under Jowar	8.09	4.63
Area under Ragi	1.11	0.89
Area under Bajra	1.46	0.75
Area under maiza	2.40	5.22
Area under Pulses	12.47	14.89
Area under Oilseeds	**23.93**	**25.21**
Area under Groundnut	17.21	14.61
Area under Castor	2.56	2.15
Area under Cash crops	**9.60**	**15.56**
Area under Cotton	4.90	10.94
Area under Chilies	1.88	2.07
Area under Other Crops	**7.24**	**7.26**

Note: The areas under the crops cultivated are presented as a share of Gross Cropped Area.
Source: Statistical Abstract of Andhra Pradesh.

The cultivation of the cash crops and oilseeds need provision of irrigation for better results. Net irrigated area witnessed negative (-0.41%) and insignificant growth in this phase. Net irrigated area as a percentage of NSA was 38.65% at the starting of the phase and it declined marginally to 38.42% at the end of the phase[8]. The area irrigated as a percentage to NSA had increased throughout the second phase whereas, it remained stagnant in the third phase. Cultivation of cash crops requires more amount of water for its success which led to private initiative in the state for the well irrigation[9]. The area under canal irrigation and tank declined significantly. Percentage of area irrigated by canal as a share of total net irrigated area was 44.05% in 1989-90; it declined to 34.30% in 2005-06. The percentage area under tanks was 24% and declined to 11.63% at the end of the phase. However, the percentage of area under well irrigation was 28.19% at the staring of the third phase and it increased to 49.33% at the

[8] Out of the total irrigated area (38.65%) in 1989-90, canal covers 17.27%, tank covers 9.28% and well irrigation covers 10.90% as a share of total net sown area. The share of total land irrigated as a percentage to net sown area has declined to 38.42% at the end of the third phase. Out of percentage of total net irrigated area canal covers 13.03%, tank covers 4.62% and well covers 18.44% as a percentage to total net sown area in 2005-06.

[9] According to the Andhra Pradesh Human Development Repot (2007), 46% of large, 34% of medium and 23% of small farmers invest on borewells in 2004.

end of the phase. Unlike the second phase, in the third phase the rate of decline in canal and tank irrigation was more prominent compared to the increase in the area under well irrigation. This reveals the fact thatssss total irrigated area witnessed hardly any change in the third phase.

Table: 4.10 Growth Rates of Factors Affecting Agricultural Income in Andhra Pradesh in the Third Phase (1989-90 to 2005-06):

AP	Growth Rate	Share in 1989-90	Share in 2005-06	Rate of Change#	Standard Dev@
Column	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Rainfall	-	1311	1147	-12.50	137.20
Gross Cropped Area	-0.33 (-1.68)	48.32	45.63	-5.57%	1.93
Net Sown Area	-0.41 (-2.23)	40.43	37.65	-6.88%	1.58
Area Sown More than Once	-0.17 (-0.41)	7.78	7.98	2.58	1.78
Total Net Irrigated Area	-0.51 (-1.52)	38.65	38.42	-0.61%	1.45
Area under Canal	-1.82 (-9.36)	44.05	34.30	-22.14%	3.82
Area under Tank	-3.97 (-8.86)	24.00	11.63	-51.55%	3.75
Area under Well	3.48 (14.27)	28.19	49.33	74.97%	7.03
Area under Other Sources	0.05 (0.14)	1.45	1.50	3.44%	10.04
Fertilizer Consumption	2.05 (5.84)	115.58	213.00	84.28%	27.62
Area under HYVs Seeds	-0.94 (-2.17)	55.50	52.44	-5.51%	5.79
Electricity Consumption	5.39 (7.58)	5477.00	14160.00	158.55%	
Area under Foodgrains	-0.88 (-3.21)	60.89	51.77	-14.97%	2.56
Area under Oilseeds	-1.04 (-2.46)	23.93	25.21	5.34%	2.00
Area under Cash Crops	2.81 (4.23)	7.59	13.01	71.40%	1.70
Area under Other Crops	0.81 0.63)	7.36	9.86	33.96	2.28

Note: The Column: 1 presents the growth rate of the factor inputs which is calculated from the actual data.
Numbers in the brackets are the t-statistics value.
Column 2 and 3 includes the percentage share of the variables at the staring and the ending year of the first phase.
GCA/NSA/ASMO = Presented as a percentage to total Geographical Area in Andhra Pradesh.
Canal /Tank /Well /Others = Represents the Percentage of area irrigated by Canal/ Tank/ well to total Net Irrigated Area.
Area under Food Crop/ Oilseeds/ Cash Crops / Other = Presented as a Percentage to Gross Cropped Area.
Rainfall includes the total amount of rainfall in the starting and the ending year of the first phase.
Area under HYV seeds – percentage to total GCA
Fertilizer consumption shows the per hectare consumption of fertilizer.
Electricity Consumption – represents the total electricity consumption in the state.
Rate of change of factors, calculated as [(value in last year- value in first year)/value in first year * 100].
@ Standard deviation of the share of the variables is presented in the table except for Rainfall and electricity consumption.
Source: Statistical Abstract of Andhra Pradesh, various issues.

Along with irrigation, the cultivation of cash crops needs adequate application of fertilizer. The utilization of modern inputs like fertilizer illustrated acceleration in the trend from 115.58 kg per hectare in 1989-90 to 213.00 kg per hectare in 2005-06 (Table 4.10). In the

third phase the consumption of fertilizer increased in the state. The growth rate of total fertilizer consumption (2.05%) was positive and significant. The area under HYV seeds showed a declining trend in the third phase. The area under HYV seeds as a percentage to GCA was 55.50 in 1989-90 then it declined to 52.44% in 2005-06. The growth rate of area under HYV seeds was negative and insignificant in the third phase. Another modern input like electricity consumption in the state also showed an increasing trend. The intensity of increase in the electricity consumption was higher in the second phase as compared to the third phase. Total electricity consumption in agricultural sector increased tremendously in the third phase. The growth rate of electricity consumption was 5.39%.

The analysis of growth rate of the inputs affecting agricultural income in the third phase shows that there was a decline in the area under food crops and a significant increase in the area under cash crops cultivation. Among the foodgrains, area under rice and other cereals declined whereas the area under pulses increased. The area under cash crops can be increased either by expanding the total area under cultivation or by irrigating more and more land. Total area under cultivation declined sharply in the state. The gross crop area and the net sown area both declined in the phase. The total land under irrigation remained stagnant in the phase. However, the composition structure of irrigated land underwent a change. Area irrigated by canal and tank irrigation declined tremendously during this phase. On the other hand, the area irrigated by well irrigation observed a sharp increase. With the provision of well irrigation and the assured form of irrigation facilities the per-hectare utilization of fertilizer increased. The percentage area under HYV seeds declined in the states. The decline in the HYV seeds might imply the withdrawal of the government intervention from the agricultural field. The private initiative was prominent in the third phase.

Five different models are considered in order to calculate the impact of the factors on agricultural income in the third phase. The correlation matrix is presented in the table: 4.11. The table shows that the modern inputs had low correlation between themselves in the third phase. The modern inputs that were highly correlated with each other in the second phase did not show any significant relation among themselves in the third phase.

Table: 4.11 Correlation Matrix of Agricultural Inputs in the Third phase (1989-90 to 2005-06):

AP	NSA	GCA	ASMO	IRRI	WELL	CANAL	TANK	FOOD	Rice	OIL	CASH	HYV	FER	RAIN
NSA	1													
GCA	**0.91**	1												
ASMO	0.49	0.50	1											
IRRI	**0.90**	0.82	0.66	1										
WELL	-0.25	-0.16	0.24	-0.03	1									
CANAL	0.75	0.67	0.33	0.72	-0.68	1								
TANK	**0.84**	0.68	0.24	0.71	-0.67	**0.88**	1							
FOOD	**0.90**	0.78	0.26	0.80	-0.41	0.80	**0.87**	1						
Rice	**0.90**	**0.83**	0.66	**0.96**	-0.22	0.82	0.80	**0.87**	1					
OIL	0.46	0.41	0.06	0.19	-0.68	0.57	0.59	0.31	0.25	1				
CASH	0.10	0.19	0.60	0.31	0.81	-0.32	-0.32	-0.16	0.14	-0.37	1			
HYV	0.68	0.62	0.62	0.72	-0.23	0.66	0.62	0.55	0.77	0.28	0.03	1		
FER	0.08	0.19	0.29	0.22	**0.86**	-0.40	-0.42	-0.09	0.04	-0.46	0.77	0.02	1	
RAIN	0.51	0.34	0.11	0.32	-0.28	0.27	0.58	0.56	0.41	0.12	0.00	0.25	-0.16	1

Note: GCA – represents Gross Cropped Area, NSA – represents Net Sown Area, ASMO – represents area sown more than once. IRRI- represents here as area under total irrigation. HYVs – represents area under HYVs seeds. FER – represents total fertilizer consumption. FOOD/RICE/OIL/CASH – represents area under foodgrains, rice, oilseeds and cash crops respectively.

The explanatory variables for the first model are area under double cropping, total area irrigated and consumption of fertilizers. Consumption of fertilizers and well irrigation were highly correlated (0.86). Total net area irrigated was also highly correlated with the area under rice (0.96), thus the model considered total net irrigated area rather than other sources of irrigation. The effect of area sown more than once and total irrigated area was negative but insignificant. The coefficient of income from agriculture was 1.17, implying, with 10% increase in the consumption of fertilizer, the income would increase by 11.7%.

The explanatory variables in the second model are total net irrigated area, area under foodgrains and consumption of fertilizer. Land under cultivation witnessed negative and insignificant impact in the phase. This implies that the importance of land led growth system had declined in the third phase. The second model thus considered change in cropping pattern as a substitute to land uses. But total area irrigated and area under paddy cultivation were highly correlated and henceforth the model considered area under foodgrains instead of area under paddy. The result shows that only consumption of fertilizer witnessed positive and significant impact on agricultural income. The effect of net area irrigated on income from agriculture was positive but insignificant. Area under foodgrains cultivation witnessed

negative but insignificant impact on the agricultural income. The coefficient of income originating from agriculture with respect to consumption of fertilizers was 1.14 (Table: 4.12) implying, with 10% increase in the consumption of fertilizers, the income would increase by 11.4%.

Area under well irrigation and consumption of fertilizer were highly correlated. Thus for the understanding of the impact of the well irrigation on agricultural income, the factors like area sown more than once, area under wells and area under paddy were considered. The impact of the land under cultivation in the form of double cropping area was negative but insignificant, where as increase or decrease in the area under paddy cultivation hardly witnessed any change in the income from agriculture. The effect of the irrigation through wells on the agricultural income was positive and significant. It implies that the effect of the private investment in terms of investment in wells witnessed high correlation with income from agriculture.

Table: 4.12 The Estimated Effects of Factors Affecting Agricultural Income in Third Phase (1989-90 to 2005-06):

Phase-III	Model-I	Model-II	Model-III	Model-IV	Model-V
C	4.49 (2.30) (0.04)	6.18 (2.60) (0.02)	3.67 (3.39) (0.01)	4.85 (5.19) (0.00)	-0.68 (-0.23) (0.82)
Area Sown More than Once	-0.04 (-0.16) (0.87)		-0.42 (-1.21) (0.25)	**-0.51**** (-2.21) (0.05)	
Net irrigated area	-0.04 (-1.51) (0.16)	0.19 (0.49) (0.63)			
Area under Wells			**0.90*** (6.57) (0.00)	**0.50**** (2.67) (0.02)	**1.30*** (3.94) (0.00)
Area under Paddy			0.22 (0.98) (0.35)		-0.26 (-0.78) (0.45)
Area under Fodgrains		-0.37 (-0.82) (0.42)			
Area under Cash Crops				**0.40**** (2.36) (0.03)	
Fertilizer Consumption	**1.17*** (10.22) (0.00)	**1.14*** (8.91) (0.00)			
Area under HYVs Seeds					**0.37**** (2.71) (0.03)
Ar(1)		-0.15 (-0.53) (0.60)			0.52 (2.71) (0.02)
R2	0.89	0.90	0.92	0.89	0.91
DW	2.07	1.88	1.82	2.10	1.96
F	36.17	23.52	18.57	28.82	22.46

Note: The first value in the parenthesis indicates the t-statistics values.
The second value in the parenthesis indicates the Probability values.
* = Significant at 1%; ** = Significant at 5%. *** = Significant at 10%.

The cultivation of cash crops increased in the state significantly in the third phase. The private investment in terms of well irrigation and consumption of fertilizers led to the cultivation of cash crops in the state. Th, the third model used the explanatory variables like

area under cash crops, area sown more than once and area irrigated by wells. The effect of the land under cultivation on income was negative and significant. It indicates that with 10% increase in the area under double cropping, the income from agriculture would decline by 5.1%. The coefficient of agricultural income with respect to area under wells and area under cash crops were 0.50 and 0.40 respectively which suggests that with 10% increase in the any of the above variables the income would increase by 5% and 4% respectively. The model is also tested by taking consumption of fertilizers instead of well irrigation and the same result was obtained.

The independent variables in the last model are area under wells, area under paddy and area under HYV seeds. The area under well irrigation and area under HYV seeds showed positive and significant impact on the agricultural income. The coefficient of income from agriculture with respect to area under paddy was negative but insignificant. The impact of well irrigation on income from agriculture was more prominent compared to the increase in area under HYV seeds. The coefficient of income with respect to area under wells was 1.30, and it is significant at 1% level. The coefficient of agricultural income with respect to land area under HYV seeds was 0.37 and significant at 5% level. The results explain that with 10% increase in any of the two variables, the income from agriculture would increase by 13% and 3.7% respectively.

The analysis of performances of factor inputs in the third phase shows that there was decline in the importance of the land under cultivation, irrigation by canal and tanks and area under foodgrains. The cultivation of cash crops and oilseeds was prominent in the phase. The increase in the cultivation of cash crops led to the increase in the well irrigation and fertilizer consumption. The impact of consumption of fertilizers and irrigation by wells on the agricultural income was positive and significant. This indicates that the third phase in Andhra Pradesh is a phase of private investment on agriculture. However, at the aggregate level, the income from agriculture did not show any significant increase in the third phase compared to the high growth in the second phase. Therefore, one finds that the withdrawal of government activities and the intervention of private initiative did not help to increase the growth rate of income to a higher level but it remained more or less stagnant.

Section: IV Factors Influencing Growth Rate of Agricultural Income in Orissa:

The present section attempts to analyze the changing importance of different factor inputs in agricultural income during different phases in Orissa. The growth performances of factor inputs as well as the impact of each input on agricultural income have been analysed separately for each phase. The compound growth rates of each variable or inputs are calculated from the actual data, and not from the percentage figures.

4.4.1 Factors Affecting Growth Rate of Agricultural Income in Orissa in the First Phase (1960-61 to 1975-76):

The first phase in Orissa starts from 1960-61 and ends by 1975-76. The compound growth rate of agricultural income was positive (2.20%) and significant. There was significant increase in the land under irrigation in the phase. The extent of land irrigated as a share of net sown area at the starting of the phase was 10.59% and it increased to 14.55%[10] with an annual rate of growth of 4.73% (table: 4.13). The composition structure of irrigation witnessed a change in the phase[11]. The area irrigated by flow irrigation and other sources declined with an insignificant growth rate of -0.76% and -1.87% respectively. However, the share of land irrigated by major sources like canal irrigation and minor sources like lift irrigation has increased significantly. Total area irrigated by major irrigation sources was 49.19% in 1960-61, it increased to 60.55% in 1975-76. However, the area irrigated by lift irrigation as a percentage to total net irrigated area was 0.36% in 1960-61, which increased significantly to 4.20% in 1975-76. The compound growth rate of land under major and lift irrigation was 1.17% and 10.23% respectively. The composition structure of irrigation sources had changed significantly towards the end of the phase. There was a decline in the area under flow and other sources and an increase in the area under major and lift irrigation.

[10] Out of total 10% of total area irrigated major irrigation sources covers 4.92% and rest area was irrigated by minor irrigation projects. Towards the end of the first phase the area irrigated by major sources doubled to 9.67% and the total area irrigated by minor irrigated sources and other sources was 5.66% as a percentage to NSA (The data for area irrigated by different sources to NSA is not presented in the table).

[11] The data regarding the irrigation sources for the state Orissa is provided in terms of major, minor and other irrigation sources. Minor irrigation again divided into lift irrigation and flow irrigation.

The increase in the irrigation potential may lead to the increase in the area under cultivation or increase in the cropping intensity, or may convert the dry land into the wet land. But the net sown area did not show an increase in the trend over the first phase, it declined from 37.24% in 1960-61 to 36.80% in 1974-75, but in the last year of the first phase, there was slight increase in the area under net sown (39.49% in 1975-76) with a growth rate of -0.07%. Total crop area in Orissa shows an increasing trend until 1966-67, there was a sharp decline in the area cultivated in 1967-68. Since then, there was upward trend in the proportion of gross area cultivated to total geographical area. The gross cropped area witnessed positive but insignificant growth rate of 0.51%. The area under GCA as a share of total geographical area was 39.49% at the beginning of the phase and it increased to 49.76% by the end of the phase. The share of neither GCA nor NSA showed a significant increase in the trend, suggesting that the area under double cropping had increased but insignificantly. The doubled cropped area witnessed positive and insignificant growth in the first phase (4.73%). Therefore, the increase in irrigation potential led to the conversion of dry land into wet lands with the existing area under cultivation.

Table: 4.13 Growth Rate of Factors Affecting Agricultural Income in Orissa in the First Phase (1960-61 to 1975-76):

ORISSA	Growth Rate	Share in 1960-61	Share in 1975-76	Rate of Change#	Standard Dev@
Column	(1)	(2)	(3)	(4)	(5)
Rainfall	-	1535.40	1323.40	-13.80%	198.61
Gross Cropped Area	0.51	39.49	49.76	26.01%	3.20

	(1.29)				
Net Sown Area	-0.07 (-0.49)	37.24	39.49	6.05%	1.07
Area Sown More than Once	4.89 (1.66)	2.25	10.45	18.81%	3.02
Total Net Irrigated Area	4.73 (12.72)	10.59	14.55	63.20%	3.33
Area under Major Irrigation Sources	1.17 (4.23)	49.19	60.55	31.44%	4.61
Area under Flow Irrigation Sources	-0.76 (-1.21)	17.59	23.02	32.37%	2.66
Area under Lift Irrigation	10.23 (4.41)	0.36	4.20	65.05%	0.27
Area under Other Irrigation Sources	-1.87 (-1.63)	32.76	12.23	-62.67%	4.49
Area under Foodgrains	1.88 (6.92)	72.46	83.91	15.80%	6.90
Area under Oilseeds	4.68 (8.64)	3.57	6.42	79.79%	0.97
Area under Cash Crops	2.86 (4.78)	1.39	1.89	19.08%	0.18
Area under Other Crops	-09.04 (4.31)	22.48	7.76	-65.48	7.60

Note: The Column: 1 presents the growth rate of the factor inputs which is calculated from the actual data.
Numbers in the brackets are the t-statistics value.
Column 2 and 3 includes the percentage share of the variables at the staring and the ending year of the first phase.
GCA/NSA/ASMO = Presented as a percentage to total Geographical Area in Andhra Pradesh.
Canal /Tank /Well /Others = Represents the Percentage of area irrigated by Canal/ Tank/ well to total Net Irrigated Area.
Area under Food Crop/ Oilseeds/ Cash Crops / Other = Presented as a Percentage to Gross Cropped Area.
Rainfall includes the total amount of rainfall in the starting and the ending year of the first phase.
Rate of change of factors, calculated as [(value in last year- value in first year)/value in first year * 100].
@ Standard deviation of the share of the variables is presented in the table except for Rainfall.
Source: Statistical Abstract of Andhra Pradesh, various issues

The conversion from dry lands to wet lands might have led to a change in the cropping pattern. The cropping pattern showed positive and significant increase in the share of area under foodgrains, oilseeds and cash crops to total gross cropped area, but a major decline was observed in the percentage area under other crops (area under other crops includes vegetable and miscellaneous tree crops). Total land under foodgrains was 72.46% in 1960-61, it increased to 83.91% in 1975-76 (Table: 4.14). Among the foodgrains, the share of area under rice to total cropped area declined insignificantly from 61.87% in 1960-61 to 60.57% in 1975-76. Except for the share of area under rice, all other cereals and pulses witnessed increase in the land under cultivation. The share of all the inferior cereals including area under maiza, jowar, bajra and ragi together was 1.64% in 1960-61, whereas the percentage to gross cropped area increased to 5.03% in 1975-76. The share of land under pulses to total cropped area was 8.05% in 1960-61 and it increased to 14.66% in 1975-76. The share of land under oilseeds and cash crops was too low compared to the share of land under foodgrains. There was only 3.57% and 1.39% of land provided for oilseeds and cash crops in 1960-61 respectively and the share of gross cropped area increased to 6.42% and 1.89% in 1975-76.

Among the cash crops masta, sugarcane and tobacco witnessed an increase in the share whereas cotton and jute had declined. The percentage of land under vegetables and spices was 22.48% in 1960-61 but the share declined sharply to 7.76% in 1975-76. The increase in the area under foodgrains, and oilseeds was due to the decline in the share of the land under vegetable and spices in the state. Even if the growth rate of area under crops increased, the total cultivable area in the state did not show significant increase which indicates that the composition structure in the land use pattern has changed. It indicates that in the state, the increase in the major irrigation sources led to the conversion of dry land into wet land and there was insignificant increase in the double cropping area. There was no expansion in the area under cultivation. But the cropping pattern showed decline in the percentage area under rice and increase in the area under inferior cereals and pulses.

Table: **4**.**14** Cropping Pattern in Orissa in the First Phase (1960-61 to 1975-76):

ORISSA	Phase-I	
	Share of Crops in 1960-61	Share of Crops in 1975-76
Area under Foodgrains	**72.46**	**83.91**
Area under paddy	61.87	60.57
Area under Maiza	0.36	1.53
Area under Ragi	1.08	3.12
Area under Pulses	8.05	14.66
Area under Oilseeds	**3.57**	**6.42**
Area under Groundnut	0.39	1.41
Area under Cash crops	**1.39**	**1.89**
Area under Cotton	0.13	0.05
Area under Jute	0.66	0.49
Area under Other Crops	**22.48**	**7.76**

Note: The areas under the crops cultivated are presented as a share of Gross Cropped Area.
Source: Statistical Abstract of Orissa various issues.

In the first phase all the factors affecting agricultural income witnessed an increasing trend except the area irrigated by flow irrigation. There was increasing irrigation facility in terms of increasing area under major and lift irrigation sources. But with the increase in the irrigation potential, there was hardly any expansion in the land under cultivation. The expansion in the area took place in terms of insignificant increase in area under double cropping. The increase in cropping intensity led to the increase in the area under food grains, oilseeds and cash crops, but the area under vegetables had declined. Even if there was a decline in the share of land under rice and increase in share of land under inferior cereals, the

proportion of area under rice constituted a major part of land under gross cropped area. The area covered by oilseeds and cash crops was almost negligible in the phase. Thus, the first phase in Orissa witnessed intensive method of cultivation with decline in area under rice and increase in area under dry cereals.

The impact of inputs on agricultural income is measured with the help of the regression analysis. The regression analysis of the factors affecting income is presented in the table 4.16. Three different models were considered for the analysis of the impact of the inputs on aggregate income. The different inputs are correlated with each other. Area irrigated through major irrigation sources is highly correlated with area under food grains and oilseeds. The correlation matrix of the inputs affecting agricultural income is presented in the Table 4.15.

Table: 4.15 Correlation Matrix of Agricultural Inputs in the First phase (1960-61 to 1975-76):

Orissa	RAIN	NSA	GCA	ASMO	IRRI	MAJOR	LIFT	FLOW	FOOD	Paddy	OIL	CASH	OTHER CROP
RAIN	1												
NSA	-0.19	1											
GCA	-0.36	0.34	1										
ASMO	-0.33	0.04	**0.95**	1									
IRRI	0.03	-0.26	0.20	0.29	1								
MAJOR	0.03	-0.15	0.26	0.32	**0.94**	1							
LIFT	-0.22	-0.50	0.09	0.25	0.74	0.64	1						
FLOW	-0.07	0.04	0.40	0.41	**0.88**	0.81	0.49	1					
FOOD	-0.04	0.06	0.48	0.49	0.83	**0.87**	0.53	**0.87**	1				
Paddy	0.12	0.04	0.47	0.49	0.79	0.79	0.49	**0.85**	**0.96**	1			
OIL	-0.21	0.12	0.52	0.51	0.80	**0.89**	0.51	0.79	0.84	0.72	1		
CASH	0.26	-0.17	0.10	0.16	0.79	0.77	0.68	0.68	0.75	0.80	0.63	1	
OTHER CROP	-0.26	0.21	0.35	0.30	-0.74	-0.73	-0.50	-0.60	-0.65	-0.61	-0.49	-0.72	1

Note: GCA – represents Gross Cropped Area, NSA – represents Net Sown Area, ASMO – represents area sown more than once. IRRI- represents here as area under total irrigation. HYVs – represents area under HYVs seeds. FER – represents total fertilizer consumption. FOOD/RICE/OIL/CASH – represents area under foodgrains, rice, oilseeds and cash crops respectively.

The explanatory variables for the first model are area sown more than once, area irrigated by lift irrigation and area under paddy. The area under foodgrains and net irrigated area were highly correlated (the correlation is 0.85). In order to avoid the multi-colinearity problem, area under paddy was considered as a proxy to the cropping pattern in the state. The estimated coefficient for income with respect to area sown more than once and lift irrigation

was negative but insignificant. The coefficient of income from agriculture with respect to area under rice was positive (2.14) and significant implying that 10% increase in area under rice leads to 21.4% increase in net income from agriculture in the first phase.

The second model considered the GCA, area under major irrigation and area under rice as the explanatory variables. The estimated coefficient of income with respect to GCA and lift irrigation was positive and insignificant. Area under rice witnessed positive and significant result. The coefficient of income from agriculture with respect to area under paddy was 1.79 (significant at 1% level). It implies that with 10% increase in the area under rice, the income would increase by 17.9%.

Table: 4.16 The Estimated Effects of Factors Affecting Agricultural Income in the First Phase (1960-61 to 1975-76):

Orissa	**Phase-I**		
	Model-I	Model-II	Model - III
C	-9.33 (-1.68) (0.12)	-6. 74 (-1.58) (0.14)	-0.63 (-0.22) (0.83)
Gross Cropped Area		0.10 (0.03) (0.97)	**0.59**** (2.05) (0.05)
Area Sown more than Once	-0.04 (-0.67) (0.52)		
Area irrigated by Major Irrigation			**0.35*** (4.57) (0.00)
Area under Lift Irrigation	-0.01 (-0.14) (0.89)	0.03 (0.09) (0.93)	
Area under Paddy	**2.14*** (3.14) (0.01)	**1.79*** (2.99) (0.01)	
Rainfall			**0.23**** (2.06) (0.05)
Ar(1)	-0.25 (-0.76) (0.46)		
R^2	0.64	0.65	0.77
DW	2.08	2.15	2.07
F	2.83	6.22	13.12

Notes: The first value in the parenthesis indicates the t-statistics values.
The second value in the parenthesis indicates the Probability values.
* = Significant at 1%; ** = Significant at 5%. *** = Significant at 10%.

The impact of rainfall on agricultural income is tested in the second model. Amount of rainfall, gross cropped area and area irrigated by major irrigation facility are considered as independent variables in the second model. All the three factors witnessed positive and significant impact on income from agriculture. Among the three factors, irrigation through medium irrigation was highly significant with 1% level of significant. The estimated coefficient of income from agriculture with respect to gross cropped area, major irrigation and rainfall were 0.59, 0.35 and 0.23 respectively. This implies that with 10% increase in any

of the variables, the income from agriculture would increase by 5.9%, 3.5% and 2.3% respectively.

Thus, it can be inferred that the first phase in Orissa is a phase of intensive cultivation with government intervention in terms of the public investment in major irrigation sources. With the increase in the area under irrigation, there was expansion in the area under foodgrains due to the increase in area under inferior cereals. Simultaneously, there was a decline in the area under vegetables. Even though the share of area under rice declined, it was still significantly higher compared to other cereals, thus revealing the positive and significant impact of rice cultivation on agricultural income.. The increase in the area under foodgrains, oilseeds and cash crops was at the cost of reduced area under vegetables and spices. Rainfall as an exogenous factor also affected the income from agriculture in the first phase.

4.4.2 Factors Affecting Growth Rate of Agricultural Income in Orissa in the Second Phase (1976-77 to 1991-92):

The second phase in Orissa covered the period from 1976-77 to 1991-92, when the aggregated income from agriculture declined compared to the first phase. In the second phase, there was introduction of the modern inputs into the agricultural field. The area under HYVs and consumption of fertilizers increased in the phase considerably (the growth rate was 9.13% and 9.63% respectively). The consumption of fertilizers per hectare of land in Orissa was 8.59 kg in 1976-77 and it increased to 19.96 kg in 1991-92. Area under HYV seeds as a percentage to total cultivable area in Orissa was 8.99% in 1976-77 and the share increased to 27.61%. The introduction of HYV in kharif season was not very successful due to unassured supply of water or some time heavy water logging, cloudy weather during rainy season susceptible to pest attach and difficulty in application of pesticides due to uncertain weather. Since 78% of area in the state was rainfed, the farmers do not initiate to take risk of making huge investments due to drought and flood which cause complicit crop failure (Mishra 1983). Thus modern inputs depend on proper irrigation facility for better results and the expansion of the area under HYVs was possible either by increase in the area under cultivation or by converting the dry lands into wet lands. There was positive and significant

increase in both gross cropped area (1.55%) and net sown area (0.41%). The percentage land under GCA was 46.39% in 1976-77 and the share increased to 63.20% in 1991-92. Net area sown as a percentage to total geographical area witnessed insignificant increase in the phase. The increase in the area under gross cropped was faster than the net sown area. It implies that there was significant increase in the double cropping in the state. The percentage area under double cropping to total geographical area was 8.57% at the beginning of the phase, it increased to 22.42% by the end of the phase. In this phase, the land use pattern showed both the expansion in the actual area under cultivation and cropping intensity.

Table: 4.17 Growth Rates of Factors Affecting Agricultural Income in Orissa in the Second Phase (1976-77 to 1991-92):

Orissa	Growth Rate	Share in 1976-77	Share in 1991-92	Rates of Changes#	Standard Dev@
Column	(1)	(2)	(3)	(4)	(5)
Rainfall	-	1013.70	1462.20	44.24	235.21
Gross Cropped Area	1.55 (7.37)	46.39	63.20	36.25%	4.57
Net Sown Area	0.41 (3.81)	37.82	40.70	7.83%	1.08
Area Sown more than	4.60	8.57	22.42	161.63	3.59

Once	(6.51)				
Total Net Area Irrigated	4.88 (19.51)	19.76	28.42	43.84%	2.95
Area under Major Irrigation	-1.31 (-5.47)	58.02	48.35	-25.88%	6.80
Area under Flow Irrigation	-1.24* (-3.30)	23.38	19.33	-26.46%	2.54
Area under Lift Irrigation	1.66 (2.66)	8.97	13.95	1513.59%	6.16
Area under Other Irrigation Sources	4.81 (5.61)	9.52	18.37	223.76	98.49
Fertilizer Consumption	9.63 (17.23)	8.59	19.96	278.03%	5.20
Area under HYVs Seeds	9.13 (15.04)	8.99	27.61	371.90	8.48
Electricity Consumption	13.85 (9.12)	34.62	271.49	922.18%	71.45
Area under Foodgrains	0.74 (3.75)	83.75	73.83	-11.84%	3.14
Area under Oilseeds	5.81 (9.11)	5.90	11.74	99.16%	1.92
Area under Cash Crops	-0.96 (-2.09)	2.14	1.59	-29.47%	0.14
Area under Other Crops	4.54 (9.52)	7.79	12.35	58.53	1.49

Note: The Column: 1 presents the growth rate of the factor inputs which is calculated from the actual data.
Numbers in the brackets are the t-statistics value.
Column 2 and 3 includes the percentage share of the variables at the staring and the ending year of the first phase.
GCA/NSA/ASMO = Presented as a percentage to total Geographical Area in Andhra Pradesh.
Canal /Tank /Well /Others = Represents the Percentage of area irrigated by Canal/ Tank/ well to total Net Irrigated Area.
Area under Food Crop/ Oilseeds/ Cash Crops / Other = Presented as a Percentage to Gross Cropped Area.
Rainfall includes the total amount of rainfall in the starting and the ending year of the first phase.
Area under HYVs seeds – percentage to total GCA
Fertilizer consumption shows the per hectare consumption of fertilizer.
Electricity Consumption – represents the total electricity consumption in the state.
Rate of change of factors, calculated as [(value in last year- value in first year)/value in first year * 100].
@ Standard deviation of the share of the variables is presented in the table except for Rainfall and electricity consumption.
Source: Statistical Abstract of Andhra Pradesh, various issues

With the increase in the area under cultivation, there was significant increase in the net irrigated area. The area under total irrigation was 19.76% in 1976-77; it increased to 28.42% in 1991-92[12]. The composition of total irrigated area changed with decline in the percentage area irrigated by major and medium sources and increase in the area under lift irrigation. The percentage share under major irrigation was 58% and it declined to 48.35% by the end of the phase. Irrigation by flow which covered 23.38% in 1976-77, declined to 19.33%. by 1991-92 Correspondingly, there was increase in the share of the lift irrigation (from 8.97% to 13.95%) with the annual growth rate of 1.66%. The area irrigated by other sources also increased from 9.52% to 18.32% with the annual growth rate of 4.81%.

[12] In the beginning of the phase out of the total (19.76%) area irrigated, 11.46% was covered by major irrigation sources, only 4.62 area of NSA covered by flow irrigation and 1.77% of area covered by lift irrigation. towards the end of the phase the percentage share of net sown area irrigated by major irrigation sources, flow irrigation, lift irrigation and other sources has increase to 15.04%, 6.01%, 4.34% and 5.71% respectively, where the total irrigated area was 28.12%.

Increase in the gross cropped area was the reflection of the expansion in the area under foodgrains and oilseeds. The actual area under foodgrains and cash crops increased in the phase but the share of the crops to the total gross crop area declined which implied that the increase in the gross cropped area was faster than the increase in the area under foodgrains. Land under food crops was 83.75% in 1976-77 and it declined to 73.83% in 1991-92. Among the foodgrains, area under pulses (from 13.42% in 1976-77 to 21.82% in 1991-92), and maize (from 1.72% in 1976-77 to 1.81% in 1991-92) showed significant increase whereas rice witnessed significant declined from 60.76% in 1976-77 to 46.30% in 1991-92 as a share of gross cropped area (Table: 4.18). Percentage area under Oilseeds witnessed significant increase with the provision of irrigation (from 5.90% in 1976-77 to 11.74% in 1991-92). The growth rate of actual area under oilseeds was 5.81% in the second phase. The share of cash crops to the total gross cropped area declined to 2.14% in 1976-77 to 1.59% in 1991-92. The share of land under other crops increased its share in the second phase from 7.79% in the starting of phase to 12.35% at the end of the phase. This shows that there was change in the cropping pattern towards oilseeds but still area under food crops covered the major portion of land in the state.

Table: **4.18** Cropping Pattern in Orissa in the Second Phase (1976-77 to 1991-92):

ORISSA	Phase-II	
	Share of Crops in 1976-77	Share of Crops in 1991-92
Area under Foodgrains	**83.75**	**73.83**
Area under paddy	60.76	46.30
Area under Maiza	1.72	1.81
Area under Ragi	3.53	2.51
Area under Pulses	13.42	21.82

Area under Oilseeds	**5.90**	**11.74**
Area under Groundnut	1.45	3.63
Area under Cash crops	**2.14**	**1.59**
Area under Cotton	0.06	0.06
Area under Jute	0.65	0.38
Area under Other Crops	**7.79**	**12.35**

Note: The areas under the crops cultivated are presented as a share of Gross Cropped Area.
Source: Statistical Abstract of Orissa.

The modern inputs witnessed significant increase in the phase where the per hectare consumption of fertilizers and percentage area under HYV seeds increased significantly. Increase in modern inputs led to a significant increase in the land under cultivation, in Orissa. GCA and NSA both witnessed increasing trend in the state. Cropping intensity also increased in the phase. Modern inputs are complimentary to irrigation thus the total land irrigated increased by increasing the area under lift and other irrigation sources. There was decline in the area irrigated by major irrigation sources in the state. The actual area under foodgrains and cash crops had increased but the share of area under both the categories to the GCA has declined. It implies the area under foodgrains and cash crops increased less than proportionately compared to the increase in the area under GCA. Area under oilseeds witnessed marked increase in the phase.

The regression analysis of factors affecting agricultural income is presented in the Table: 4.20. The variables considered in the second phase for the analysis witnessed the mixture of some traditional inputs and modern inputs. Irrigation was highly correlated with all the modern inputs as well as the traditional inputs like land under cultivation (Table: 4.19). The correlation matrix of agricultural inputs in Orissa is presented in the Table: 19. The table also shows that the modern inputs like fertilizer, area under HYV seeds and electricity are highly correlated with irrigation and cropping pattern.

Table: 4.19 Correlation Matrix of Agricultural Inputs in the Second Phase (1976-77 to 1991-92):

	RAIN	NSA	GCA	ASMO	IRRI	MAJOR	LIFT	FLOW	FER	HYV	FOOD	OIL	CASH
RAIN	1												
NSA	0.76	1											
GCA	0.64	**0.85**	1										
ASMO	0.57	0.75	**0.99**	1									
IRRI	0.55	0.68	**0.85**	**0.85**	1								

MAJOR	0.53	0.67	0.83	0.83	**0.97**	1							
LIFT	0.53	0.57	0.74	0.75	**0.97**	**0.90**	1						
FLOW	0.53	0.65	0.72	0.70	**0.95**	**0.94**	**0.92**	1					
FER	0.54	0.72	0.82	0.81	**0.98**	**0.94**	**0.94**	**0.96**	1				
HYV	0.60	0.75	**0.91**	**0.90**	**0.96**	**0.96**	**0.88**	**0.90**	**0.95**	1			
FOOD	0.69	0.85	**0.94**	**0.91**	0.65	0.60	0.55	0.50	0.63	0.75	1		
Rice	0.61	0.62	0.32	0.21	0.34	0.23	0.34	0.41	0.37	0.31	0.42	1	
OIL	0.51	0.73	**0.94**	**0.95**	**0.91**	**0.92**	0.81	0.80	0.89	**0.95**	0.78	1	
CASH	0.04	-0.04	-0.17	-0.20	-0.54	-0.52	-0.57	-0.62	-0.56	-0.43	0.08	-0.30	1

Note: GCA – represents Gross Cropped Area, NSA – represents Net Sown Area, ASMO – represents area sown more than once. IRRI- represents here as area under total irrigation. HYVs – represents area under HYVs seeds. FER – represents total fertilizer consumption. FOOD/RICE/OIL/CASH – represents area under foodgrains, rice, oilseeds and cash crops respectively.

The explanatory variables in the first model are gross cropped area, area under lift irrigation and area under rice. Gross cropped area was highly correlated with area under foodgrains (0.94). Thus the model considered area under rice as the explanatory variable as it covers more than 60% of land in the state in the second phase. The elasticity of income from agriculture with respect to gross cropped area was 1.32, implying more than proportionate response in agricultural income, with the changes in gross cropped area. It shows that 10% increase gross cropped area would increase the income by 13.2%.

The modern input like HYVs is highly correlated with total irrigated area and also with different sources of irrigation. In order to avoid the problem, the present model considered HYVs along with area under rice and net sown area. Area under HYV seeds was also correlated with gross cropped area and area under double cropping. Thus the model considered net sown area to analyse the importance of land under cultivation with modern inputs. Net sown area had significant and positive effect on the dependent variable. The elasticity of income from agriculture with respect to net sown area was 4.59. It shows that 10% increase in the NSA would lead to the 45.9% increase in the net income from agriculture, implying more than proportionate response in income.

Table: 4.20 The Estimated Effects of Factors Affecting Agricultural Income in the Second Phase (1976-77 to 1991-92):

ORISSA	Model-I	Model-II	Model-III	Model-IV
C	-11.56 (-1.36) (0.20)	-27.32 (-1.83) (0.09)	-10.79 (-1.27) (0.22)	-9.68 (-1.34) (0.20)
Gross Cropped Area	**1.32**** (2.46) (0.02)			
Net Sown Area		**4.59**** (1.99) (0.05)		
Area Sown			0.35 (0.93)	

More than Once			(0.36)	
Lift irrigation	-0.01 (-0.52) (0.61)			0.01 (0.38) (071)
Area foodgrian			**2.77**** (2.97) (0.05)	**2.09**** (2.23) (0.04)
Area under Rice	0.99 (1.01) (0.33)	-0.47 (-0.34) (0.74)		
Area under HYV seeds		-0.02 (-0.12) (0.91)		
Consumption of Fertilizer			0.16 (1.35) (0.19)	
Rainfall				-0.02 (-0.09) (0.93)
Ar(1)				
R	0.65	0.62	0.65	0.63
DW	1.79	2.10	1.87	1.86
F-stae	4.08	4.35	4.99	3.89

Note: The first value in the parenthesis indicates the t-statistics values.
The second value in the parenthesis indicates the Probability values.
* = Significant at 1%; ** = Significant at 5%. *** = Significant at 10%.

Fertilizer consumption is another important modern input which witnessed significant increase in the phase. In order to analyse the impact of the fertilizer consumption on agricultural income, the explanatory variables that are considered for the third model are area under double cropping, fertilizer consumption and area under foodgrains. Area under foodgrains witnessed positive and significant impact on the dependent variable. The elasticity of income from agriculture with respect to area under foodgrains was 2.77. Area under foodgrains witnessed more than proportionate response to income. The result shows that 10% increase in the area under foodgrains led to 27.7% increase in the income from agriculture. The effect of the fertilizer consumption was positive but insignificant in the phase.

The independent variables for the last model are area under lift irrigation, area under foodgrains and rainfall. Lift irrigation was highly correlated with the modern inputs like area under HYV seeds and fertilizer consumption. The result shows that the estimated coefficient of income with respect to area under foodgrains was 2.09. It implies that with 10% increase in the area under foodgrains, the income will increase to 20.9%. The effect of lift irrigation was positive but insignificant and that of rainfall was negative and insignificant.

The above analysis of factor affecting agricultural income suggests that there was an increase in application of modern inputs in the state. The expansion of the area under cultivation in the second phase was significantly higher compared to the first phase. The land under cultivation increased and the cropping pattern showed decline in the area under foodgrains and increase in area under oilseeds. Among food grains area under rice had declined but

pulses had increased. The analysis of impact of the inputs on aggregated income shows that land under cultivation and area under foodgrains witnessed positive and significant impact on income. Even if there was increase in the uses of modern inputs in the second phase, the effect of the same on agricultural income was not significant. This suggests that green revolution had minimal impact on the agriculture in Orissa. There was no substitution from land-based growth towards technology based growth process.

4.4.3 Factors Affecting Growth Rate of Agricultural Income in Orissa in the Third Phase (1992-93 to 2005-06):

The third phase of agricultural income in Orissa ranges from 1992-93 until 2005-06. In the third phase, there was momentous decline in the growth rate of agricultural income compared to the second phase. In this phase, both gross cropped area and net sown area declined. The rate of decline in GCA (-1.76%) was faster than the rate of decline in the NSA (-0.93%) correspondingly there was sharp decline in the area cropped more than once (-3.56%). Percentage of area under net sown was 40.43% in 1992-93 which declined to 37.61% in 2004-05. The share of GCA was 60.59% in 1992-93; it declined sharply to 50.69% by 2005-06. The area under double cropping also declined from 20.02% at the starting year of the phase to 14.14% by the end of the phase. This shows there was neither expansion of land under cultivation nor the increase in the cropping intensity. But the total net area irrigated illustrated a positive (2.04%) and significant growth rate in the third phase.

Table: 4.21 Growth Rates of Factors Affecting Agricultural Income in the Third Phase (1992-93 to 2005-06):

Orissa	Growth Rate	Share in 1989-90	Share in 2005-06	Rate of Changes#	Standard Dev@
Column	(1)	(2)	(3)	(4)	(5)
Rainfall	-	1344	1658	23.36	225.74
Gross Cropped Area	-1.76 (-5.81)	60.59	50.68	-17.27%	4.85
Net Sown Area	-0.93 (-10.89)	40.57	36.55	-10.08%	1.54

Area Sown more than Once	-3.56 (-4.13)	20.03	14.14	-29.51	3.36
Total Net Area Irrigated	2.04 (12.10)	32.33	35.59	32.87%	3.74
Area under Major Irrigation	0.31 (2.18)	47.45	50.02	5.66%	1.12
Area under Flow Irrigation	0.02 (0.14)	18.94	20.01	5.64%	0.51
Area under Lift Irrigation	0.55 (5.47)	13.74	14.97	8.95%	0.70
Area under Other Irrigation Sources	-1.87 (-1.63)	19.87	15.61	-21.43	1.48
Fertilizer Consumption	4.85 (7.83)	21.55	46.00	85.61%	8.33
Area under HYVs Seeds	1.19 (3.65)	30.00	43.07	33.55%	5.13
Electricity Consumption	-0.62 (-2.47)	280.14	183.11	-34.64%	102.76
Area under Foodgrains	-1.53 (-6.47)	73.77	78.02	4.00%	1.82
Area under Oilseeds	-4.36 (-6.62)	11.60	9.47	-21.11%	1.31
Area under Cash	2.68 (4.15)	1.33	1.66	68.63%	0.19
Area under Other Crops	-2.72 (-2.74)	12.71	10.45	-33.72%	1.31

Note: The Column: 1 presents the growth rate of the factor inputs which is calculated from the actual data.
Numbers in the brackets are the t-statistics value.
Column 2 and 3 includes the percentage share of the variables at the staring and the ending year of the first phase.
GCA/NSA/ASMO = Presented as a percentage to total Geographical Area in Andhra Pradesh.
Canal /Tank /Well /Others = Represents the Percentage of area irrigated by Canal/ Tank/ well to total Net Irrigated Area.
Area under Food Crop/ Oilseeds/ Cash Crops / Other = Presented as a Percentage to Gross Cropped Area.
Rainfall includes the total amount of rainfall in the starting and the ending year of the first phase.
Area under HYVs seeds – percentage to total GCA
Fertilizer consumption shows the per hectare consumption of fertilizer.
Electricity Consumption – represents the total electricity consumption in the state.
Rate of change of factors, calculated as [(value in last year- value in first year)/value in first year * 100].
@ Standard deviation of the share of the variables is presented in the table except for Rainfall and electricity consumption.
Source: Statistical Abstract of Andhra Pradesh, various issues

The amount of net area irrigated in the third phase was 32.33% in 1992-93 it increased to 35.59 percent in 2005-06[13]. The increase in the total area under irrigation was due to the increase in growth rate of major irrigation, flow and lift irrigation sources. Flow and lift irrigation comes under minor irrigation. The area irrigated by major source like canal irrigation as a percentage to total net irrigated area was 47.45% in 1992-93; and it increased to 50.02% in 2005-06 with an actual area growth rate of 0.31%. The growth rate of actual area under flow irrigation was positive (0.02%) but insignificant. Lift irrigation sources

[13] The percentage area irrigated increased in a declining trend in the state. Out of the total 32.33 percentage (as a percentage of NSA) of area irrigated, 15 percent contributed by major irrigation sources and 8%, 6.21% and 6% contributed by flow, lift and other sources respectively (the shares presented as a percentage to total NSA). The percentage share has increased over period with 20% of NSA irrigated by major sources, 8.00%, 6.57% and 6.12 percent of area irrigated by flow, lift and other irrigation sources respectively.

witnessed an increasing trend in the third phase (from 13.74% to 14.97%), but the percentage area under lift irrigation was lower in comparison to area under flow and major sources. The growth rate of actual area under lift irrigation was positive (0.55%) and significant. With the significant increase in the area under irrigation, the application of modern inputs witnessed rise in the trend in the third phase. The growth rate of total area under HYV seeds (1.19%) and consumption of fertilizer (4.85%) was positive and significant. The area under HYV seeds as a percentage of GCA accelerated from 30% in 1992-93 to 43.07% in 2005-06. The per hectare consumption of fertilizer was also increased from 21.55 kg per hectare to 46 kg per hectare in 2005-06.

With the increase in the irrigation potential and increased use of modern inputs, one may expect the increase in the production of more market oriented crops rather than traditional crop cultivation. Actual area under foodgrains and oilseeds declined in the phase. But the area under foodgrains as a share of GCA witnessed an increasing trend. It implies the decline in the area under GCA was much faster than the decline in the actual area under foodgrains. The share of area under foodgrains to GCA was 73.77% in 1992-93 and it increased to 78.02% in 2005-06 (Table: 4.22). Among the foodgrains, area under ragi, jowar, pulses and other cereals declined significantly; whereas the area under rice witnessed increase (from 47.19% to 59%) in the share of land cultivated. The percentage area under oilseeds declined from 11.60% in 1992-93 to 9.47% in 2005-06. Total area under cash crops showed a positive (2.68%) and significant growth in the phase. But the total area provided for cash crops was 1.33% as a percentage of GCA, it increased to the level 1.66% in 2005-06. The positive growth rate in the area under cash crops was primarily due to the increase in the area under cotton (increased from 0.06% to 0.38%); it shows there was increase in area under rice and cash crops in the third phase.

Table: **4.22** Cropping Pattern in Orissa in the Third Phase (1992-93 to 2005-06):

ORISSA	Phase-III	
	Share of Crops in 1992-93	Share of Crops in 2005-06
Area under Foodgrains	**73.77**	**78.02**
Area under paddy	47.19	59.00
Area under Pulses	21.07	17.64
Area under Maiza	1.80	2.11
Area under Ragi	2.43	2.45

Area under Oilseeds	**11.60**	**9.47**
Area under Groundnut	3.88	4.56
Area under Cash crops	**1.33**	**1.66**
Area under Cotton	0.07	0.38
Area under Jute	0.31	0.52
Area under Other Crops	**12.71**	**10.45**

Note: The areas under the crops cultivated are presented as a share of Gross Cropped Area.
Source: Statistical Abstract of Orissa various issues.

In Orissa the total land under cultivation declined in the third phase, correspondingly there was decline in the area under double cropping. The total area irrigated witnessed an increasing trend over the phase. The composition structure of irrigation has changed where the area irrigated by major and lift irrigation increased significantly. With the increase in the irrigation facility, the per hectare consumption of fertilizer and percentage area under HYV seeds showed increasing trend in the third phase. But the growth rate of area under HYV seeds was lower compared to the significantly higher growth rate in the second phase. The area under foodgrains increased but area under oilseeds declined. It shows that in the third phase the cultivation of foodgrains was higher compared to other crops. In the second phase, the share of area under rice declined with the increase in the area under pulses and oilseeds but in the third phase there was specialization towards rice cultivation in the state.

The correlation matrix of the different inputs is presented in the Table: 4.23. The factors affecting agricultural income in the third phase witnessed decline in the correlation among them as compared to the second phase. The modern inputs area under HYV seeds and fertilizer was correlated with each other. The estimated equations of the factors affecting agricultural income is presented in the Table: 4.24.

Table: 4.23 Correlation Matrix of Agricultural Inputs in the Third Phase (1992-93 to 2005-06):

Orissa	GCA	ASMO	NSA	IRRI	MAJOR	FLOW	LIFT	FER	HYV	FOOD	RICE	OIL	CASH	OTH	RAIN
GCA	1														
ASMO	**0.98**	1													
NSA	**0.90**	0.81	1												
IRRI	-0.93	-0.90	-0.85	1											
MAJOR	-0.89	-0.81	-0.94	**0.90**	1										
FLOW	-0.86	-0.77	-0.92	0.85	**0.96**	1									

LIFT	-0.68	-0.60	-0.76	0.74	0.80	**0.88**	1									
FER	-0.74	-0.70	-0.74	0.80	**0.92**	0.84	0.71	1								
HYV	-0.54	-0.50	-0.55	0.64	0.76	0.63	0.55	**0.93**	1							
FOOD	**0.98**	**0.94**	**0.92**	-0.88	-0.87	-0.88	-0.72	-0.67	-0.41	1						
Rice	0.35	0.32	0.39	-0.25	-0.18	-0.16	-0.23	0.11	0.27	0.43	1					
OIL	**0.96**	**0.91**	**0.94**	-0.92	-0.93	-0.88	-0.71	-0.77	-0.57	**0.94**	0.44	1				
CASH	-0.49	-0.40	-0.62	0.46	0.73	0.67	0.61	0.83	0.86	-0.43	0.18	-0.50	1			
OTHER	0.23	0.26	0.08	-0.29	-0.24	-0.34	-0.34	-0.33	-0.22	0.23	-0.30	0.11	-0.21	1		
RAIN	0.50	0.55	0.32	-0.41	-0.18	-0.06	0.08	-0.03	0.05	0.43	0.53	0.43	0.16	0.01	1	

Note: GCA – represents Gross Cropped Area, NSA – represents Net Sown Area, ASMO – represents area sown more than once. IRRI- represents here as area under total irrigation. HYVs – represents area under HYVs seeds. FER – represents total fertilizer consumption. FOOD/RICE/OIL/CASH – represents area under food grains, rice, oilseeds and cash crops respectively.

The explanatory variable for the first model are area under lift irrigation, area under rice and are under HYV seeds. The modern inputs like area under HYV seeds and fertilizer consumption are correlated with each other, thus the model considered only one variable of modern inputs. The estimated elasticity of income with respect to lift irrigation and area under rice was 0.72 and 3.33 respectively. This implies that for every 10% increase in any of these two factor inputs, the income from agriculture in the economy would increase by 7.2% and 33.3%. The response of area under rice to the income from agriculture was more than proportionate compared to the area under lift irrigation.

The impact of land under cultivation and the irrigation facility along with the modern inputs like fertilizer consumption is tested in the second model. In this model, area sown more than once and fertilizer consumption witnessed positive and significant impact on income from agriculture. The impact of major irrigation was negative but insignificant. The estimated coefficient of income with respect to area sown more than once and fertilizer was 0.28 and 0.37 respectively (both are significant at 5% level). It implies that with 10% increase in any of the variables, the income will increase by 2.8% and 3.7% respectively. This shows that the area sown more than once and fertilizer uses were less responsive to income in the third phase. Again, there was decline in the area under double cropping in the state but the importance of the same on the agricultural income was positive and significant. This may imply that the decline in the land under cultivation led to the decline in the aggregated income from agriculture.

Table: 4.24 The Estimated Effects of Factors Affecting Agricultural Income in the Third Phase (1992-93 to 2005-06):

Orissa	Phase-III			
	Model-I	Model-II	Model-III	Model-IV
C	-27.35 (-1.94) (0.09)	3.80 (1.64) (0.13)	5.78 (1.35) (0.21)	-5.23 (-0.46) (0.65)
ASMO		**0.28**** (2.07) (0.05)		
major		-0.02 (-0.72) (0.49)		
Lift	**0.72**** (2.21) (0.05)			
food			-0.09 (-0.20) (0.84)	
Rice	**3.33**** (2.59) (0.02)			1.05 (0.72) (0.49)
fertilizer		**0.37**** (2.10) (0.05)	0.11 (0.78) (0.45)	
HYV	-0.56 (-1.31) (0.23)			0.32 (1.07) (0.31)
Rain			**0.43*** (3.41) (0.01)	**0.63**** (2.72) (0.02)
R	0.66	0.59	0.69	0.65
DW	2.19	1.79	2.00	1.80
F	2.26	2.28	5.87	5.73

Note: The first value in the parenthesis indicates the t-statistics values.
The second value in the parenthesis indicates the Probability values.
* = Significant at 1%; ** = Significant at 5%. *** = Significant at 10%.

The independent variables for the third model are area under foodgrains, fertilizer consumption and amount of rainfall. The importance of exogenous factors like rainfall and modern inputs like fertilizer consumption were analysed in the third model. Only the amount of rainfall witnessed positive and significant impact on income. The estimated elasticity of income from agriculture with respect to rainfall was 0.43 and significant at 1% level. With 10% increase in the rainfall, the income from agriculture would increase by 4.3%. The last model considered area under rice, amount of rainfall and area under HYV seeds as the independent variables. The result was similar to the earlier model. Only the amount of rainfall witnessed significant impact on income rather than the application of modern inputs.

The third phase in Orissa witnessed decline in land under cultivation and specialization towards paddy cultivation in the state. Even if there was decline in the area under cultivation but its importance on the agricultural income remained prominent. Thus, the decline in the rate of growth of income from agriculture in the third phase might be due to the decline in the land under cultivation. There was increase in the use of modern inputs but it hardly affected the income from agriculture. The factor that showed highly significant impact on income was

amount of rainfall. The utilization of modern inputs did not help the agricultural sector much in the state and the income from agriculture was highly influenced by rainfall. Thus, the last phase in Orissa can be called as traditional inputs based growth process.

Section V: Conclusion

The analysis of the factors affecting the growth rate in agricultural income in the two states observes that the factors accounting for the growth rates are different from one phase to the other. The first phase in Andhra Pradesh witnessed a phase of intensive cultivation with an increase in the public provision of irrigation and area under double cropping. While the second phase witnessed increased importance of modern inputs, the third phase was charecterised by diversification towards cash crops and increased private initiative in terms of investment in well irrigation. This shows that the Andhra Pradesh agricultural sector witnessed a transformation from traditional based cultivation system towards modern agriculture over the phases. In the case of Orissa, the first phase witnessed an intensive cultivation with an increase in the irrigation and the diversification towards inferior crops like bajra and jowar. Even though the second phase showed increased use of modern inputs, the aggregate income declined. The decline in the aggregate income was reflected by the decline in the land under cultivation. This reveals that in the second phase the realization of the inputs towards output was negligible. Thus, only land related factors like land under cultivation and area under foodgrains witnessed significant influence on the aggregate income. However, it emerges that in the so called green revolution phase, Orissa did not witness any shift from the traditional agricultural system towards the modern agricultural system. During the third phase, one finds that the aggregate income declined in Orissa, for which, one among the major influencing factor being the amount of rainfall. It implies the third phase represents a natural/traditional economy where the importance of the modern technology is less.

Chapter: V

Phase-wise Analysis of Cycles in Agricultural Income in Two States

Introduction:

Performance of agricultural sector has two indicators: trend and year-to-year fluctuations. The trend component is captured by the rate of growth of the sector over the period of time. The year to year fluctuation is captured by the increase/decrease in variability in trend line. The variability is measured by using the indices like Coefficient of Variation (CV), Standard Deviation (SD) and by counting the number of cycles existing in the series. The fluctuation in agricultural output or income has been analyzed in a number of literatures by comparing the variability between the period before and after green revolution. The common conclusion that emerged from the past studies is that; the fluctuation has increased after the introduction of new technology [Mahendradev (1987) Mehra (1981) Hazell (1982) Ray (1983) Pal and Sirohi (1988) Rao, Ray and Subbarao (1988)]. The fluctuation in the crop output for all categories of crops except for wheat increased significantly in the post green revolution period (1966-1985), when compared to that in the pre-green revolution period (1950-1965) at all India level (Rao, Ray and Subbarao 1988, Mehera 1981, Hazell 1982). The state-wise comparison of fluctuation in agricultural output shows that Punjab, Haryana, J&K, Kerala, Bihar and Rajasthan have recorded a statistically significant declining trend of variability over the period whereas rest of the states have witnessed increase in the variability (Dev 1987, Singh 1984). However, the sources of fluctuation in production or income can be different from one economic system to another. Different economic systems may have different combination of production structures, thus generating different types of cyclical behaviour pattern in the growth process. In the traditional economic system, the fluctuations in the natural factors like the variation in rainfall generate the fluctuation in the aggregate level. A good rainfall year leads to the increase in land under cultivation that in turn increases the output and income. The land under cultivation depends upon the amount of rainfall, thus all fluctuation in the traditional economic structure is mainly nature-defined. In a relatively modern economic structure, on the contrary, the fluctuation in the modern inputs and the market leads to the fluctuation in the aggregate income or output. In this context, the present chapter tries to analyse the variability in the aggregate income series in

Andhra Pradesh and Orissa. An attempt has been made here to understand the co-movement of the factor inputs with the agricultural income. With the process of transformation from a traditional to a modern economic structure, one can expect the co-movements of the nature related factors with income to reduce and the co-movements of the modern technology with agricultural income to increase.

The present chapter is organized in seven different sections. The first section of the chapter makes an attempt to analyse the generation of a cycle at the economy level and in the agricultural sector. The second section discusses the trend of variability in agricultural output or income as explained by the past studies. This section also presents the different measures used in the literature to capture the year to year variability in agricultural output and income. The third section explains the methodology used in the study. The cyclical pattern of the aggregated income from agriculture for the whole period, as well as for each phase, is analyzed in the fourth section. The co-movements of the income from agriculture with the factor inputs in different phases in Andhra Pradesh and Orissa are examined separately in the fifth and the six section respectively. The last section provides the summary and the conclusion of the chapter.

Section: I Why Does Cycles Exist in an Economy?

The Business cycle theory of Macro economics explained the existence of cycle in the economy. The up and down behavior of economic activity is called as cycles. The economic activities that lead to the short run fluctuations are output, employment and prices. The history shows that the economy never grows in a smooth and even pattern. Business cycles generated by the macro economic activities last for a period of 2 to 10 years marked by widespread expansion or contraction in most sectors of the economy. Business cycles have two phases – Recession and Expansion. Recession is a stage explained by decline in total output, income and employment usually lasting from 1 to 6 year and is marked by widespread contraction in many sectors of the economy (Mankiw 1989). A depression is a recession that is major in both scale and duration. Business cycles generally never resemble each other. The irregularity of business cycles is similar to the fluctuation of weather.

There are two theories of business cycles (1) Exogenous Theories. (2) Internal Theories. According to exogenous theories the sources of business cycle is the fluctuation of factors outside the economic system like war, revolution and election, gold discoveries and migration, in discoveries of new lands and resources in scientific break through and technological innovations even in climate change or weather. Internal theories suggest that the mechanisms inside the economic system give rise to self generating business cycles. The multiplier-accelerator theory explains the internal business cycles. The multiplier theory explains that the exogenous shocks are propagated by the multiplier mechanism. According to the theory rapid output growth stimulates investment. High investment in turn stimulates more output growth and the process continues until the capacity of economy is reached, at which point the economic growth rate slows. The slower growth in turn reduces investment spending and inventory accumulation, which tends to send the economy into recession. The process then works in reverse through which it reaches trough and the economy then stabilizes and turns upward again.

The business cycles theories can be explained by demand side factors or by supply side factors. The real business cycles theories gave emphasis on the supply side shock to generate the cycles. On the other hand the Kenysian theories attributed the business cycles to the demand shock. The Keynesian theories of business cycles explain the demand side shocks like change in fiscal policy, tests, velocity and autonomous investment. The shock in aggregate demand creates cycles in the economy. Fluctuation in output, employment and prices are caused by shift in aggregate demand. When the consumer spending or government spending change relative to the economy's productive capacity it leads to the shift in the aggregate demand. These shifts in aggregate demand lead to sharp business downturns and the economy suffers recession or even depressions.

The real business cycles theories holds that innovations or productivity shocks in one sector spread to rest of economy that cause recession or boom. In this approach the cycles exist primarily by shocks in aggregate supply and not by change in aggregate demand. According to the real business cycle theory those forces that lead to the change in Walrasian

equilibrium can cause the economic fluctuation. The Walrasian equilibrium is simply the set of quantities and relative prices that simultaneously equate supply and demand in all markets in the economy. The change in the level of government purchases or in the investment tax credit alters the demand for goods in turn affect the Walrasian equilibrium. The increase in the government purchases leads to increase in the demand for goods. To achieve the equilibrium in the goods market the real interest rate must raise, thus reducing the consumption and investment. The real-business cycle theorists say that an important cause in fluctuation is the rate of technology change. Suppose, for example, the rate of technology slows down. As a result, people's marginal productivity will drop so the real wage will fall. People will react to that change in real wage in a rational manner by shifting their work and leisure decisions over time. When there is a technological shock raising real wage, people will work more causing output to surge, and when there is a technological shock lowering real wage, people will withdraw from work, causing output to fall. This pattern is what we observe as booms and recessions.

Cycles in Agricultural Sector:

Similar to the cyclical behavior at the economy level, the agriculture sector also witnesses uneven growth pattern. Agricultural sector also gets influenced by some exogenous and endogenous factors. Rainfall is considered as one among the exogenous factor while the endogenous factors can be the introduction of new technology or a change in the demand for output. However the causes for the generation of the cycles in the agricultural sector vary from developed countries to the less developed countries. The relation between the fluctuations in aggregate output and the components of aggregate demand has been well documented for industrial countries. In industrial countries, the agricultural cycles are mainly investment led and influenced by the change in industrial output. On the contrary in a less developed economy there is low correlation between level of output and prices (Agenor, Dermott and Prasad 2000). Thus the cycles in the sector are not primarily influenced by the demand side factors. The less developed countries have its own structure of the economy which itself creates cycles in the agricultural sector.

In a traditional economy, knowledge on the production process is generally low and nature is an active player in the organization of agricultural production. “There is a long history of pre-science agriculture, during which there were some innovations, some discoveries and some learning from trial and error”. But pre-science agriculture, then and now (for it still prevails in many parts of the world) is at the mercy of the vicissitudes and niggardliness of nature [Schultz (1972), p-362]. Schultz recognizes the importance of nature in the organization of production in the traditional economy. If the nature has some cyclical behavior, the production system, which is nature dependent, would also mimic this cycle. Individuals will take action to reduce the impact of the cycle on them. But the levels of production and the income derived from the production system will also have a cyclical behavior dominantly defined by nature. The cyclical character of nature, which is exogenous to the agents, generates a cycles in the levels of production and the income derived from it.

One of the indicators of the cyclical behavior of nature is the amount of rainfall. The extent of rainfall changes each year with some years of good rainfall and some years of average and some years of bad rainfall. A general opinion in the Indian conditions is that once in four years, a drought year occur leading to a cyclical behavior. The extent of land cultivated depends on the extent of rainfall generating co-movements in the variables. The extent of land cultivated has an important impact on the level of production in the economy. On one hand there is a co-movement between rainfall and land cultivated, on the other hand there is co-movement between the land cultivated and the level of production. Individuals do make a choice, either individually or collectively, to reduce the effect of the cyclical behavior of the economy on them. At a broad level these choices can take three forms. One is related to cropping pattern, while the second is the expansion of the land under cultivation, and the third is the provision of irrigation.

According to the given amount of rainfall the farmer diversify from one crop to another to reduce the risk. For example if the rainfall level is low then the farmer makes a choice to shift from cereals to the production of dry crops. The farmer takes a decision regarding the number of crops to be cultivated so that even if one crop fails due the adverse effect of rainfall, the agent can gain something from the other crop (Hazra 1982). Shift in the

cropping pattern over a period of time can influence the fluctuation in output at different levels. It may lead to comparative advantage caused by changes in infrastructural conditions. A shift in cropping pattern in favor of crops which are highly sensitive to rainfall can result in increasing fluctuation in total crop output (Rao Ray, Subarao 1988).

The increase in production by expansion of the land under cultivation can be termed as the extensive method of cultivation. Expanding the land under cultivation also covers inferior lands. Inclusion of more and more inferior lands might lead to high fluctuations or decline in output and income. According to Rao, Ray, Subarao (1988), in the phase of significant area expansion, marginal and less fertile land might have been increasingly brought under cultivation thus the yield from such marginal land would be more sensitive to variation in rainfall, which might have contributed to increased instability in yield. Thus the type of cycles that defined in this period can be nature based cycle or due to the expansion of inferior lands under cultivation.

Another way by which the adverse effect of nature based cycle can be reduced is by improving the irrigation facility, as irrigation is a substitute to rainfall. The impact of nature-based cycle can be reduced with the provision of irrigations. These generally take the form of tanks in the Indian context. Also public investment in irrigation projects helped in reducing the impact of the rainfall cycles on agricultural production. The relation between irrigation and the growth of productivity according to S.K Ray (1971) was that the most important proximate cause of disparities in the growth of crop output during 1952-53 to 1964-65 i.e. the difference in growth of irrigation. The quality of irrigation is also important though its effect is difficult to measure empirically (Vaidyanathan 2000, Mehara 1982).

Another feature of traditional agrarian economy is its semi-closed nature i.e. its interaction with the outside world is minimum. In agrarian sector major portion of the demand is due to external economy. In such a situation there are low co-movements between income from agriculture and the non-agricultural sector. In a traditional system, the cycles in the performance of agricultural sector is nature dependent and this would reflect in the income

originating from this sector. One would expect co-movements of income with rainfall-land cultivated and low co-movement with income originating from non-agricultural sector.

In sharp contrast a modern economy is a science based system as well as a market driven system of organization of production. A science-based agriculture attempts to change the agricultural practices in the system with a substitution of technology for land. Modern agriculture would be impossible without scientific knowledge. This knowledge, when it has become transformed into inputs, techniques and into the skills of man, it becomes the most important factor in production. In the Indian context it took the form of application of seed-fertilizer technology into the agricultural fields. The aim of the introduction of seed-fertilizer technology was to increase the yield without the expansion of the area under cultivation. High-yielding varieties of seeds are early maturing semi-dwarf that under intensive agricultural practices (chemical fertilizer, irrigation, pumps, threshers etc.) provides a significant higher yield compared to the traditional types (Parayil 1992). These changes were instituted in place of the traditional agricultural practice involving the use of seeds whose genetic makeup goes back to thousands of years. The application of new technology assumed to increase the level of output produced. The year-to-year fluctuations in inputs used can be an important source for year-to-year fluctuation in the production and income in the economy. The fluctuations in inputs usages can be due to two reasons. One, the modern inputs need to be purchased in the market and the fluctuation in prices may be an important reason for fluctuations in input usages (Hazell, 1982). Two, there could be a constraint on the availability of the inputs if it is provided by the State. So in this economic condition, one would expect a high co-movement between the income/production and the usage of modern inputs where as low co-movements with land.

The agricultural sector gets integrated with the non-agricultural sector through the markets in a modern economy. This process of integration can also generate cycles in the income originating from the agricultural sector. One of the important sources for demand for agricultural goods is the demand originating from non-agricultural sector. If the income from non-agricultural sector has a cyclical behavior then the demand for goods produced in agriculture will also have a cyclical behavior with prices adjusting according to the market.

So one would expect a co-movement between agricultural income and non-agricultural income. The agricultural prices also witness year-to-year fluctuations depending on the market conditions, which have implications on the income originating from agriculture. The present study does not analyse the co-movement of prices and income originating from agriculture.

One dominant opinion on the green revolution package deal is that it is very sensitive to the provision of complimentary inputs or is it the natural conditions (Mehra 1981, Rao, Ray and Subbarao 1988, Pal and Sirohi 1988). According to Rao, Ray, Subharao (1988), Parayil (1992), Mehara (1982) and Dev (1987), new technology is very sensitive to rainfall. There exists an inverse relationship of gains in stability with rainfall and is traceable to the fact that fluctuation in rain-fed farming across states tends to rise with the decline in rainfall level. Again the production process is highly sensitive to the variation in seasonal conditions between regions and crops in given years, affecting the adaptation of the high yielding verities differently in different parts of India (Mukhopadhyay 1976). Water supply being determined by both irrigation and rainfall, and cropping pattern being a function of water supply, it is more significant to view productivity in relation to rainfall, irrigation and fertilizer (Vaidyanathan 2000). There is a strong relationship between the fluctuation of fertilizer use and the spread of irrigation across regions. A linear relationship among all these variables and their contribution to production suggests that all the above variables have significant impact on productivity and they account for 60-70 percent of the yield variation. According to Dev (1989), 78 percent of the variance in per hectare yields across 56 regions at different points of time is explained by rainfall, irrigation and fertilizer. Unlike traditional economy, where the nature based cycles have a co-movement with land, in a modern economy system the co-movement are with other complementary inputs.

Along with the new seed-fertilizer technology, private and public provision of irrigation is also significant since twenty nine percent of the total variation in the foodgrain production can be explained by irrigation alone (Mehara 1982). The inter-regional variation in output per unit of cropped area bears a significant positive correlation with the irrigation ratio. Again the productivity differential between irrigated and rainfed land is inversely related to

the level of rainfall, i.e. irrigation makes a much greater difference to land productivity under conditions of low rainfall than in high rainfall regions (Vaidyanathan 2000). Empirical evidence suggests that from the period between 1952-53 to 1964-65 the fluctuation of rice production was highest in Punjab (the standard deviation was 0.25), but with the emergence of HYV seeds of rice and expansion of tube-well irrigation there was shift of rice to the area of better soil and assured irrigation facility. Thus after the spread of new technology the variability of rice yield declined in Punjab (the standard deviation was 0.18 in 1967-68 to 1977-78). But in Tamil Nadu and Karnataka, where the irrigation system lets the water flow from field to field, water control and management was much poor. The spread of new technology of rice to cover 73% of rice total area in Tamil Nadu and 48% in Karnataka by 1975-76 along with high application of fertilizer, without good water control and management, could have increased the variability of rice yield significantly (from 0.09 to 0.19 and 0.08 to 0.19 in Tamil Nadu and Karnataka respectively). Thus quality of irrigation and the proper management of irrigation are more important than just the provision of irrigation facilities. For example a tank irrigation system may prove vulnerable to drought itself, thereby failing to protect irrigated farming. On the other hand, tube-well is intrinsically capable of more than insulating farming against at least a single drought.

The variability in the modern agricultural system is also depended on the information and the knowledge available for the agent. There was lack of understanding of the necessary economic requirements in less developed countries for efficient adoption and use of new superior agricultural inputs (Schultz 1972). The information regarding the use of high yielding varieties seeds are generally provided by the respective state governments. Extension services, Krishi vigyan Kendra, and the government demonstration are the important government sources of providing the information to the agents. But the data regarding the households assessing information about new technology shows that only 0.7% of house holds participated in Krishi vigyan Kendra, 5.7% of households attended the extension services and only 2% of households participated in government demonstration works. Nearly 60% of farmer households did not have access to any sources of information on modern technology during one year. There were only three sources which were assessed by more than 10% farmers households: “other progressive workers” (16.7%), input dealers

(13.1%) and radio (13%) in all India. Among the different sources of information in Andhra Pradesh, Gujarat and West Bengal a sizeable number of farmers depended in the progressive farmers (34%, 30% and 25% respectively), where as in Punjab, Rajasthan and Orissa the share was just 4.3%, 5.3% and 7% respectively. The dependence on the input dealers was also high in Andhra Pradesh (30%), Gujarat (24%) and West Bengal (35%), in contrast to the lowest dependence in Kerala (2.8%), Punjab (3.6%), Rajasthan (5.6%) and Orissa (8.2%). Only two states, Andhra Pradesh and West Bengal, witnessed around 60% of household gathering information from any sources. The share of households gathering information from any sources, in Rajasthan and Orissa was below 25%. This shows that there was wide variation in the information channel in different states. Due to the lack of information, the knowledge was incomplete for the agent which may in turn generate higher fluctuation in the agricultural production.

The above analysis suggest that in a traditional economy the cycles in production and income are a response to cycles generated by nature, where high co-movements is with nature-rainfall-land and low co-movements with non-agricultural income. In a modern economy there is an increasing usage of the modern inputs in the production process and market interactions increases. In this system one would expect a co-movement between input usages and income on the one hand and with non-agricultural income on the other hand. But the modern system is said to be very sensitive to natural conditions and complimentary inputs and so the amplitude of the cycles are magnified due to small variation in these conditions. Under the conditions of incomplete transformation, nature based cycles and modern input based cycles co-exist in these economies. But the relative importance of nature based and modern input based cycles depends on the relative importance of the two sectors in the economy. In a state/region, if the traditional economy dominates, the nature induced cycles will be more important in influencing income and vice versa.

Section: II Literature on Short Run Fluctuations in Agricultural Income:

The fluctuation in agricultural income has been analysed in different literatures at all India as well as at state level. Literature uses different methods to measure the year to year fluctuation in agricultural income or output. Henceforth, in order to understand the intricacy of objectives of some identical studies, conducted in Indian context, the relevant empirical research studies are reviewed under the following sub-heads with regard to this chapter.

5.2.1 Methods used for Estimating the Trend in Short Run Fluctuations in Indian Agriculture:

There are broadly two different methods to measure the short run fluctuation in agricultural output or income. One set of literature emphasizes on measurement of short run fluctuation by counting the cycles in the series and by measuring the size of amplitudes. The other set of literature emphasizes on measuring instability by using standard deviation and coefficient of variation.

The short run fluctuation in the agricultural production was calculated by counting the number of cycles in the series by Das (1978) for the four eastern states. The study calculated the short run fluctuation of foodgrain output in Orissa, West Bengal, Bihar and Assam for the period 1950-51 to 1975-76 by dividing the first period as 1950 to 1965 and the second period as 1966 to 1975. The study also measured the deviation of cycles from trend line, which is called as the amplitude of the cycle. The growth performances of the above four states were low compared to other Indian states. The constant weighted aggregate indices of agricultural and foodgrain production was constructed and calculated for all four states by considering the all India average peak marketing period prices of the principal crops of the triennium 1951-60 to 1961-62. The peak points and trough points of cycles were counted. When the rate of increase in the peak points is higher than the trough points it makes the short run fluctuation a divergence series. The result shows that Bihar, Assam and Orissa witnessed divergent in series but in West Bengal it showed a convergent series. This indicates that there was growing fluctuation in the production of foodgrain in the states of Assam, Bihar and Orissa, while it was comparatively stable in west Bengal. The result for total agricultural production also indicated the similar trend.

The study by Tripathy (1990) analysed the cyclical pattern of the agricultural crop output with respect to area, production and productivity of all crops and some selected crops in Orissa for the period 1950-51 to 1979-80. The cycles in agricultural production was calculated by the difference between the levels of production in good years over bad years. The differential rate of increase in the good years and bad years shows the nature of variability. The short run fluctuation increases when the difference between the peak points and trough points increases over a period of time. Each crop is transformed into simple index number taking 1956-57 as the base year. The result shows that the index numbers of area, production and yield, undergoes 8, 9 and 10 cycles respectively. The crop wise analysis shows that the divergent trend in fluctuation was due to the increase in variability of rice and partly through the fluctuation of the other growing group crops. The convergent trend in fluctuation of the growing commercial crops did not make a significant impact on the totality because of their insignificant contribution to the totality in terms of area as well as production.

Another set of literature analysed the short run fluctuation by measuring the instability level. Instability in agricultural production and output was calculated by using standard deviation (SD) and coefficient of variation (CV). Standard deviation used as an absolute measure of instability and coefficient of variation is a relative measure of instability. The degree of variation measured by SD or CV shows the deviation from trend.

Mahendradev (1987) measured the trend of instability in rice, wheat, cereals and pulses production, instead of measuring instability at one point by using standard deviation for the period 1960-61 to 1984-85. The whole period was divided into three sub periods, like, 1960-61 to 1969-70, 1970-71to 1979-80 and 1980-81 to 1984-85. Standard deviation of agricultural production was more than 20% in Gujarat, Rajasthan, Maharashtra, Bihar, Orissa and Madhya Pradesh. It was between 15 to 20% in Haryana, Karnataka, and Tamil Nadu. On the other hand Punjab, Assam, Andhra Pradesh recorded less than 15% variation. The period wise analysis indicates that there was a progressive but marginal decline in instability of total output at the all India level. Punjab, Haryana, Kerala, Bihar and Rajasthan

witnessed decline in the instability where as Maharashtra, witnessed insignificant downward trend and Tamil Nadu, Assam, Karnataka, Orissa and West Bengal showed a significant upward trend in the instability for the period 1960-61 to 1984-85. The rest of the states and all India showed insignificant upward trend in instability. The instability trend for wheat had declined for most of the states. Crop wise analysis shows that there was an increase in instability for rice and a decline for pulses on the other hand coarse cereals and pulses recorded insignificant decline in instability over the period. Trend of instability declined for wheat in all states except for Himachal Pradesh and Maharashtra. The study suggested that trend of instability affected by importance of irrigation in stabilizing production**.**

According to Mehra (1981), the increase in the Standard Deviation was much higher for foodgrains than non-foodgrains for the period 1949-50 to 1977-78. The whole period was divided into two phases; the first phase was the period before new technology and the second period was after the adoption of new technology. The instability in the second period for all crops had increased compared to the first phase. As yield and area are two main component of production, thus instability in yield and area may leads to instability in production. Production variability is mainly dominated by fluctuation in yield. The CV for yield decreased for total crops and for non foodgrains except for foodgrains. The CV of area under all the three variables declined. The variability of area under crops showed decline in trend even though there was an increase in mean area. On the other hand mean yield was accompanied by an increase in yield variability. This implies that the production instability is primarily generated by the yield instability, which was invariably higher than area instability in the period. Yield variability continued to be dominant for production instability both before and after adoption of new technology.

An attempt has been made by Hazell (1982), to find whether variation in yield, area or the interaction between the components, contributes to instability in cereal production in India for the period 1954-55 to 1977-78. The study compared the instability in pre and post green revolution of cereal production. The instability level had increased from the first period to the second period. The CV of total cereal production was 5.85, during the second period, which was nearly 50 percent larger than the CV (4.5%) during the first period. The inter-

state analysis of instability in cereals production indicates that Tamil Nadu, Rajasthan, Maharashtra, Karnataka, Gujarat, Andhra Pradesh and Kerala showed a significant increase in the CV, where as Gujarat, Haryana, Assam, Orissa and West Bengal showed trivial increase in the CV. The change in the yield variance is the important source of the increased instability in most of the states. It accounts for half of the increase in the variance of total cereal production in Andhra Pradesh, Karnataka, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal and for two third in Gujarat and two quarter in Maharashtra . However, changes in yield variances had stabilizing effects on total cereals production in Assam, Bihar, Utter Prasad, Madhya Pradesh and Punjab. Changes in the mean and variances of area were most important factors in accounting for changes in the variance of total cereals production in those states where the yield variance effects were negative. In Punjab for instance, the increase in area under cultivation accounted for more than half of the increase in the variance of total cereal production.

A study by Ray (1983), examines the nature of instability in Indian agriculture for the period 1950 to 1980 for different crops. The result reveals that for each of the successive decades instability generally shows a tendency to increase. Instability in production index was low during the 1950s for all the crops and crop total except tobacco. The standard deviation (SD) increased in the 1960s, and rose further for most of the crops during the 1970s. Except the production of wheat, all individual crops and crop aggregates under foodgrains became progressively unstable. The average intensity in cotton and oilseed production did not record any noticeable change over 1960s and 1970s. Excluding three crops sugarcane, jute and tobacco, the variability in the year-to year changes in area did not appear to be the major cause for production instability. Variability in the area growth rates was relatively high in the 1950s. It had declined in the 1960s but it increased again in the 1970s. Change in the cropping pattern played a minor role in making the production indices of crop aggregated unstable. The major sources for production instability turned out to be yield fluctuations. Variability in annual yield growth rates and its corresponding impact on production instability seems to be declining over decades. The correlated changes in area, yield and cropping pattern showed increasing tendencies to reinforce the variability in output growth

rates. The synchronized movement in year to year changes in area and yield indices strengthened progressively over decades.

The instability of foodgrain production and productivity in Punjab and Orissa was analyzed by Singh (1984), for the period 1961-61 to 1978-79. The whole period was divided into two sub period like 1960-61 to 1969-70 and from 1970-71 to 1978-79. The deviations of the production and productivity for individual years from the trend lines was calculated by using two methods mainly "coefficient variation" (CV) and "comparison of mean squares" for different periods. The CV for Punjab foodgrain production in the first period was 14.79 and it declined to 9.40 in the second period. In Orissa the CV had increased from 10.68 to 13.07 in the second period. The CV for foodgrains yield in Punjab also declined from 10.55 to 7.05. In the case of Orissa it increased from 10.94 to 11.06. The analysis of instability by using the mean square method also provided the same result. The mean square for production and yield declined for Punjab. However, both mean square of production and yield increased in case of Orissa. Thus the instability level declined in Punjab but it increased in case of Orissa over the period.

The study by Pal and Sirohi (1988), examines the sources of growth and instability in production of commercial crops like sugarcane, groundnut, cotton, jute, potato for the period 1949-50 to 1984-85. The whole period divided into two period like 1949-50 to 1964-65 and from 1967-68 to 1984-85. They used CV as measure of instability. To find the variance of production it was decomposed into area variance, yield variance, area-yield covariance terms. The result shows, decrease in production was accompanied by the increase in production instability in groundnut, jute and potato in the period 1967-68 to 1983-84. Instability level declined insignificantly in case of sugarcane and cotton. Yield instability increased for groundnut and Jute whereas it decreased for sugarcane and potato. The proportions of variance attributed to area-yield covariance, increased in all the crops except potato. The study suggests that the instability was more prominent in disaggregated production at state level and may be much higher at farm level.

The study by Rao, Ray and Subbarao (1988) measured instability in foodgrains, oilseeds and total crop for period 1950-51 to 1985-86. In order to understand the impact of the green

revolution on instability they break the whole period into two phases. The result shows that fluctuation for all crops except wheat increased significantly in post green revolution period (1966-67 to 1985-86) compared to the pre green revolution period (1950-51 to 1965-66). Increase in the variability was highest in case of oilseeds followed by coarse cereals and pulses. State wise analysis indicates that the instability level has increased for the state, Assam, Gujarat, Karnataka, Maharashtra, Orissa, Rajasthan and Tamil Nadu in the second phase compared to the first phase. In Uttar Pradesh and Andhra Pradesh the instability level for foodgrains remained same and in rest of the states the CV declined in the second phase. Punjab and Kerala witnessed significant decline in the CV.

Using coefficient of variation as the measure of instability, Singh (1989), suggested that the yield variability in case of rice was highest i.e. 29.14% for Punjab followed by the state of Rajasthan, Uttar Pradesh, Andhra Pradesh, Orissa, Gujarat, Bihar, west Bengal, Himachal Pradesh and Jammu & Kashmir in 1971-1986. The CV of rice production was lowest i.e. 6.11% for the state of Assam. The states having the highest yield variability were found to be having the highest average yield per hectare. But in case of wheat the states having higher yield variability had lower average yield in general. Hence it may be noted that wheat is a more assured and stable crop than rice. There was no much interstate variation in yield variability of gram. The major cotton growing states such as Punjab, Haryana, Gujarat, Tamil Nadu and Rajasthan showed greater yield stability. States like Tamil Nadu, Maharashtra, Madhya Pradesh, Karnataka and Andhra Pradesh showed the stability in sugarcane production with low CV and complimentary higher per hectare yield.

The inter-regional disparity and instability in agricultural growth from the period 1978-79 to 1987-88 was analysed for Orissa by Panda (1992). On basis of nature of soil and rainfall the state was divided into four natural regions. The regions are coastal plain, the central table belt, the northern plateau and Eastern Ghats. Area, production and yield of three principal group crops like cereals, pulses and oilseeds were taken into consideration. The study used CV to find yield instability of crops over the time periods. Higher yield instability was found in the central table compared to any other regions of the state. Instability was high in central belt for cereals and for pulses. Instability for cereals and for pulses was lowest in central belt

also. Crop wise instability was observed to be maximum with oilseed and minimum with pulses in almost all the regions during the reference period.

The study by Radha and Prasad (1999)**,** measured the instability level of agricultural crop production by using CV and Coppock's instability index from the period 1972-73 to 1992-93. They examined the level of instability in pre and post National Agricultural Research Project (NARP) in north Telangana zone. The instability indices of rice and maize were high for production during pre and post NARP periods followed by instability in area for rice and yield for maize. This shows that higher instability in rice production was mostly due to area while for maize it was mainly due to yield. With increase in area as well as production of rice, the instability indices decreased during the second period. Area under maize had experienced wide variation during ex-post NARP, but instability of production as well as yield decreased to a larger extend after NARP period. Similar type of study conducted by Bharathi, Shareefi and Raju (1992), uses Coppock's instability index, CV and SD for measuring instability in pulses production in major growing districts and for the state as a whole. The result suggests that the contribution of area to production was more evident rather then yield. Moreover the instability in yield levels was more evident which caused further instability in production levels.

Jha (1994), calculated instability in gross return, yield and farm harvest prices by estimating coefficient of variation around the trend (CVt), in the district Kurukshetra for the period 1972-73 to 1990-91. A linear trend was fitted to the time series data on yield, price and whenever the trends was significant the CV for unadjusted data was multiplied by the square root of the unexplained portion of the variation in the trend equation. The higher instability in oilseeds was because of high CVt (153%) in first period i.e. 1972-73 to 1980-81. Even if most of the crops except gram and paddy recorded decline in CVt over time, the decline was maximum (88.5%) for rabi oilseeds. Pulses remained as the most risky crop during the second period. Over the year wheat established itself as one of the most stable crops. Maize and cotton showed decline in instability in gross return in second period while instability in yield increased, so there was the importance of price instability in explaining the instability in gross return. The maximum instability in farm harvest prices of oilseeds during the

second period was due to severe supply demand imbalances in oilseeds during the late 1980s.

Sharma, Singh and Kumari (2006) analysed the relation between increase in the production of foodgrains and instability level. There was an increase in average production of major foodgrains in nineties compared to eighties. According to the study, increase in the yield was the most important source of increase in the average production of individual crops and total foodgrains. The change in variance of yield accounts for a whopping 97%of the total decrease in the variability of foodgrain production. The changes in yield variance and interaction between changes in mean area and yield accounted for nearly whole of the percentage change in the variance of total foodgrain production.

Study regarding the fluctuation in agricultural production in Andhra Pradesh shows that in the post green revolution the variability has increased (Raju and Rao 1988). The study covered the period from 1956-57 till 1982-83 and the period 1956-57 to 1968-69 was considered as the pre green revolution phase and 1969-70 to 1982-83 was considered as the post green revolution phase. The results show that growth in the movements of agricultural production was marketed by instability.

The common conclusion that emerged from the above analysis of the trend of variability at all India shows the year to year fluctuation of the crop production increased over the period. State wise analysis witnesses that there was regional difference on the variability level from one period to another period. Some states showed an increase in variability whereas others showed a decline in the variability. Again the crop wise analysis showed that there was decline in the fluctuation for some crops like wheat and increase in variability for cereals and some non food crops. Most of the studies suggested that yield variability is the main source of the variability in the total production. Except in Punjab the area variability declined in all most all the states. Cropping pattern change is also considered as one of the factors responsible for the increase in the production fluctuation.

The factors responsible for the sources of variability in production or yield were examined in few literatures. Ray (1981), suggested that rainfall is the most important nature

determined stochastic variable that is responsible for the sharp fluctuations in production. The variation in rainfall affects growth pattern in production and the instability is influenced by the distributional pattern of the rainfall indices over 1950-1970. Even the new technology led to increase in the sensitivity of crop production to the variation in rainfall and prices in India. According to Singh and Gangwar (1986), the variability in the production of coarse grains was more than the variability in area and yield. The study identified three factors that are responsible for the change in variability in production. Price effect was the most powerful factor in the changes of value of production of all coarse grains and pulses. The second important factor was the yield effect. The third influence was from the area effect which adversely affected the value of production. Gangwar and Pandey (1982) examined the stagnation in production of pulses and pointed out that the trends of total pulses with respect to area, production and yield were statistically non-significant, reflecting the stagnation in production of pulses in the country. In spite of high prices of pluses, wheat and other HYV cereals became profitable due to their substantially higher and more stable yield. This was also due to the shift of good land from pulses to HYV cereals. Thus, land under cultivation is also one among the factors that influence the variability in production. According to Das (1978), the fluctuation in agricultural performance can be explained by variation in rainfall, expansion of area under cultivation towards inferior crops, use of fertilizer, inadequate irrigation facilities and absence of better farming methods. The favorable monsoons led to increase in agricultural production due to increase in both yield and area.

5.2.2 Growth Rate and Short Run Fluctuations in Indian Agriculture:

The opinion regarding the relationship between growth and instability was quite contradictory in the literature. One set of literature suggested that there exists positive relation between growth and instability whereas others suggested no unique relationship between growth and instability. The detailed analysis of the literatures regarding the relationship between growth and instability is presented in this sub section.

The relationship of growth rate and instability was first examined by Sen (1967) in Indian context particularly for foodgrain production. According to the study there was greater

instability during the periods of growth in 1900-01 to 1923-24 and 1951-52 to 1965-66, and less instability during the period of stagnancy 1936-37 to 1950-51. During 1900-01 to 1923-24, while the foodgrain production increased on the average at 0.3% per annum, the peak points showed a rising trend of 0.81 percent per annum on the average, and the trough points showed a declining trend of 0.14 percent. During 1951-52 to 1965-66, while foodgrain production registered an unprecedented rate of growth of 2.75%per annum, the instability in production continued to increase. On the other hand he observed that during 1936-37 to 1950-51 the foodgrain production was fairly stable while the general trend was stagnant.

The analysis by Panda (1992), found a positive association between higher growth in yield and higher fluctuation in case of oilseeds in Orissa. Only one climatic zone of the state (eastern ghat), witnessed a little deviation where higher yield growth in oilseeds has been associated with lower degree of instability. Ramakrishna (1993) also suggested that there exists a positive association between fluctuation and agricultural productivity. However the same association can not be attributed between production and area. Jah (1994), also pointed out that higher growth rate was accompanied with higher instability in crop yield.

Another set of literature suggested that there exists no exclusive relationship between growth and instability level. According to Rao, Ray and Subbarao (1988), there is no unique relationship between the degree of instability and the growth rate of crop output. There is also no correlation between the change in rates of growth and change in degree of instability in foodgrains output between 1961-70 and 1971-85. Out of the twelve states experiencing deceleration in the growth rate of output, four states experienced a sharp rise in instability while six experienced a sharp decline in it. Thus the study concluded that the annual instability in output is not caused by growth or stagnation as such.

Singh (1984), tried to find the relationship between growth and instability by taking two states into consideration; Punjab and Orissa. In Punjab the growth rate was 9.54% in the first period (1960-61 to 199-70) and in declined to 5.15% in second period (1969-70 to 1978-79). Also in Orissa the growth rate was 2.16 in the first period and declined sharply to 0.96%. During the entire period the overall growth rate in Punjab was 8.01, where as in case of

Orissa it was 1.19, which was very low. There was an increase in the instability level in both the states as both coefficient of variation and mean square deviation from trend shows an increase in the value. According to him, there is no one to one relationship between growth rate of foodgrain and instability level in state of Punjab and Orissa.

While determining the relationship between growth and instability of crops production in Maharashtra, Deshpande (1991), found a strong negative relationship between growth and instability in pre-new technology period, which changed to a positive but non-significant association after the advent of new technology. Region wise analysis over the three decades revealed that the relationship emerged stronger in the case of non drought prone districts than the drought prone areas. The results indicated instability as a companion of growth for drought prone region which is not true in the case of non drought prone districts. The low instability and high growth combination was observed in the case of drought prone districts whereas a higher instability low growth combination was found in non drought prone districts.

According to Das (1978) there is no significant trend in between growth rate and instability, as the growth rate of all states shows a positive growth rate but instability did not show any particular trend as such. In Assam the impact of green revolution was negative. This shows that the state turned into a state of growing instability in the production of foodgrains. Even if the average periodicity of decline in peak points remained same after green revolution; but the decline range was 4.6% to 9.7%, in the four years before green revolution. The average periodicity of decline in peak points ranged from 8.3% to 11.8% in the green revolution period. The growth rate of peak points and trough points indicate that though during green revolution there was growing instability in production, it was less severe compared to the pre-green revolution period. The impact of green revolution in foodgrain production in Bihar indicates that there was an increase in variation. In West Bengal green revolution has a beneficial impact as regards the variation in foodgrains production. While the pre-green revolution period there was growing instability in the foodgrain production, there was damped oscillation during the green revolution period.

The above discussion regarding the measure of short run fluctuation shows that the literatures mainly used two methods to measure instability levels. The first method was by calculating the cycles and amplitudes. The second method used in literatures is the CV or the Coppock's instability index to measure the instability level in agricultural output or income. The present study used the number of cycles as a measure of variability in the agricultural income trend in two states.

The existing literature emphasizes on the contribution of area and yield to the output while analyzing the factors related to short run fluctuation in crop production. The cycles in the factor inputs can lead towards the cycles at the aggregate level. There was hardly any empirical study regarding the increase or decrease in cycles in the factor inputs. This study is an attempt to analyse the behaviour of the factor inputs over the period of time and the co-movements of the aggregate income and variables.

Section-III Methodology:

The present chapter proposes to study the year-to-year fluctuation of agricultural sector over the period in different phases. There are two different methods for measuring fluctuation in agricultural output or income. The present study calculates the year to year fluctuations in the agricultural income by counting the number of cycles present in the series. The aggregate cycle in the income from agriculture is generated by a process of aggregation of cycles over the multiple agents in the economy. Individual agents can have cycles in their income but in the process of aggregation, the cycles might cancel (or increase) each other and on the aggregate there can be low (high) aggregate cycles. Given that, income originating in agriculture has cyclical behaviour, generally moving averages are used to smoothen the series but this paper does not use a moving average but considers the actual series[1].

[1] The number of years to be taken to calculate the moving averages have been varying.. Mahendra dev (1987) has taken a nine year moving average, Virmani (2005) took five years moving average. In the process of smoothening the series, if the cycles as assumed by the authors is not similar to the natural cycles there is a possibility of introducing new errors into the series. In the process of solving a problem one may be introducing new errors into the system.

As the data set starts from 1960-61, the starting point cannot be considered as the maximum or minimum point. Assuming the data shows an increasing trend the first maximum point in the series is considered as the starting point of the cycle. The cycle has two parts a contraction and an expansion part. A cycle is considered to be full when a contraction in the series leads towards the trough point, and after reaching the minimum point it again expands and reaches to the peak point. More precisely a cycle is generated when a trough point takes a peak and then a trough point. Thus the peak and troughs mark the turning points of the cycle. For example the first cycle in the series starts with the initial point of the series and it is considered full when it takes the immediate maximum value and starts declining and reaches the minimum point. In this study the cycles are calculated by counting the total maximum points present in the series.

A related measure of importance is the height/depth of the cycles, which is called as the amplitudes of cycle. Amplitude is calculated by subtracting the maximum points with its immediate minimum point, which captures the difference between the two points. Dividing this value by "two" gives the deviation from the trend line. For example, consider a series with five cycles, it has five maximum and five minimum points, subtracting each maximum point with the corresponding minimum point and dividing by "two" gives the points of deviation from the trend line in the series. The average of all the amplitude value gives the average size of the amplitude in the series. In the present study the average size of amplitudes for each phase is considered for analytical purpose. The amplitudes also help to analyze whether a series is diverging or converging. A series is called as divergent when the growth rate of the maximum points is greater than the growth rate of the minimum points. A series is called as divergent when the growth rate of the minimum points is higher than the growth rate of the maximum points. The present study also calculated the instability level in income from agriculture by using coefficient of variation and standard deviation in each phase as well as for the whole period.

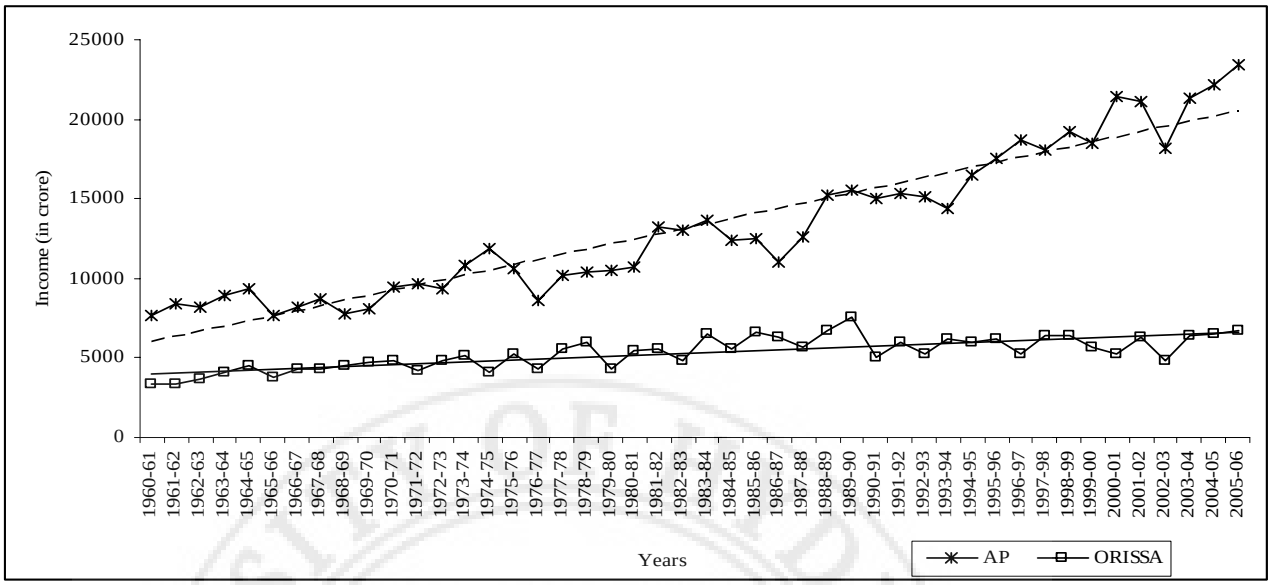
One of the important features in the study of cyclical pattern is the recognition that variables fluctuate together or there exists co-movement between variables. In the case of agriculture, production/income has co-movement with rainfall, inputs used etc. The co-movements

between the income and the factor inputs are measured by the correlation coefficient between income and the set of inputs used in the analysis. When the changes in one variable affect the other variable, the two variables are said to be correlated. If the two variables move in same direction i.e if the increase or decrease in one results in a corresponding increase or decrease in other, correlation is said to be direct or positive. The correlation coefficient lies between -1 to +1, if the value is +1, the correlation is perfect and positive and if the value is -1, correlation is perfect and negative. If the correlation coefficient is zero then the variables are independent to each other. When correlation coefficient of two factors is high, then the co-movements between the two factors are considered to be strong.

Section: IV Variability in Agricultural Income in the Two States:

The cyclical behaviour pattern of the agricultural income in two states is presented in the figure: 5.1. The cyclical behaviour pattern of agricultural income for the whole period in two states shows that, Andhra Pradesh has less number of cycles compared to Orissa in the whole period. Total number of cycles in the income from agriculture series in Andhra Pradesh was 13 where as the total number of cycles in Orissa was 14.

Figure: 5.1 Cycles in the Agricultural Income in Andhra Pradesh and Orissa for the Whole Period:



Source: Statistical Abstract of Andhra Pradesh and Orissa various issues.

The table-5.1 shows the analysis of cyclical behaviour in net income from agriculture for both the states. Andhra Pradesh witnessed more number of cycles than Orissa. The average length of cycle was 3.47 years for Andhra Pradesh, and 3.21 years for Orissa. This indicates that in Orissa the cycles of net income from agriculture re-occurs relatively more frequently than in case of Andhra Pradesh.

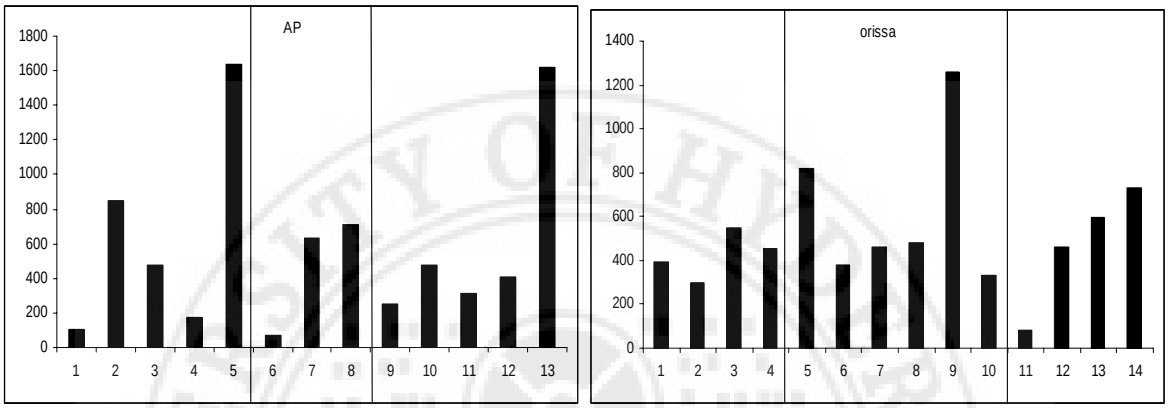
Table: 5.1 Variability in Agricultural Income in Both the States for the Whole Period:

STATES	**ANDHRA PRADESH**	**ORISSA**
Periods of Analysis	46 years	46 years
Growth Rate	2.42%	1.14%
No. Cycles	13	14
Average Length of Cycle	3.47 years	3.21 years
Average size of Amplitudes	592.88	519.79
GR of Maximum Points	8.09	2.43
GR of minimum Points	8.47	2.50
Nature of Series	Convergent	Divergent
Mean (in crore)	13270.10	5279.11
Standard Deviation	4501.37	993.41
Coefficient of Variation	33.92	18.70

In case of Andhra Pradesh the average size of amplitudes was 592.88 which was higher than the amplitude in case of Orissa (519.79). The total number of cycles was less in the case of Andhra Pradesh when compared to Orissa, but the amplitude of the cycles was larger in Andhra Pradesh. The figure: 5.2 shows that the average size of amplitudes is Andhra

Pradesh was higher than Orissa because two amplitudes (amplitude no. 5 and 13) in phase one and phase three was considerable higher than the rest. But the size of amplitudes in Orissa was relatively higher in all the periods when compared to Andhra Pradesh.

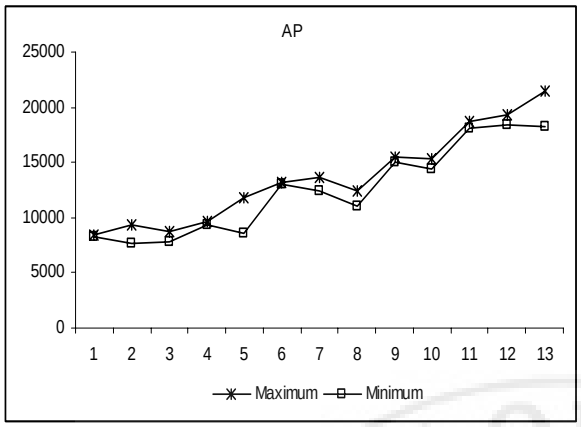
Figure: 5.2 Size of Amplitudes in Income from Agriculture for Andhra Pradesh and Orissa (1960-61 to 2005-06):

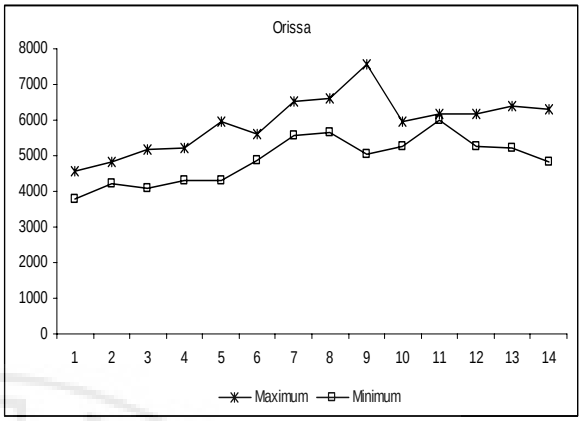


Sources: Statistical Abstract of Andhra Pradesh and Orissa various issues.

All the maximum and minimum points in the income series is plotted in the graph 5.3. The graph shows the in Orissa the difference between the peak and the trough points was wider than Andhra Pradesh. The growth rate of the maximum and the minimum points are calculated for the whole period. The growth rate of maximum points in Andhra Pradesh was 8.09% and the growth rate of the minimum points was 8.47%. The growth rate of minimum points was higher than the growth rate of the maximum points implying the fact that the income series in Andhra Pradesh is converging over the period. In case of Orissa, the growth rate of the maximum points was 2.43% and the growth rate of the minimum points was 2.50%, thus implying that the series is a divergent series.

Figure: 5.3 Maximum and Minimum Points in Agricultural Income in Andhra Pradesh and Orissa (1960-61 to 2005-06):





Sources: Statistical Abstract of Andhra Pradesh and Orissa various issues.

The higher amplitude of the cycles led to higher coefficient of variation in the series. The average income from agriculture in Andhra Pradesh (13270.10) (table-1) was higher than Orissa (5310.11) and also the instability of agricultural income was high in Andhra Pradesh compared to Orissa. The coefficient of variation of agricultural income in Andhra Pradesh was 33.92, and in Orissa the CV was 18.70. It implies that the agricultural income from Andhra Pradesh in a relative sense was more unstable or variable than Orissa. The standard deviation for agricultural income was 4501.37 and for Orissa it was 993.42.

The above analysis suggests that income from agriculture in Andhra Pradesh witnessed more number of cycles and higher amplitudes compared to Orissa. However, even if the number of cycles were higher in Andhra Pradesh, the series shows a converging trend over the period.

5.4.1 Phase-wise Analysis of Variability in Agricultural Income:

Andhra Pradesh:

Cycles in agricultural income in Andhra Pradesh for different phases is presented in the table. 5.2. In Andhra Pradesh agricultural income cycles shown an increase over the phases. The average length of the cycles in the first phase was 3 years. It implies that on an average in every three years one cycle occurs in Andhra Pradesh. There were total 5 cycles in the first phase and the number of cycles declined to 3 in the second phase. Thus the average

period of occurrence of a cycle in the second phase was not frequent like the first phase. On an average, in every 4.66 years one cycle occurs in the second phase. The number of cycles increased in the third phase, thus the average year of occurrence of a cycle was frequent. On an average, in every 3.4 years one cycle occurs in third phase. This shows that compared to the second phase, the third phase in Andhra Pradesh was relatively unstable. The average amplitudes of the cycles were calculated for each phase. The average size of amplitudes in the first phase was 645.15; it declined to the 469.09 in the second phase and again increased in the third phase to 614.42. The growth rates of maximum and the minimum points in each phase is separately calculated and is presented in the table: 5.2. In all the phases the growth rate of the maximum points was higher than the growth rate of the minimum points. Thus the series witnessed divergent trend in every phase. At the disaggregated level the nature of the each series was divergent whereas the whole period witnessed a convergent series.

Table: 5.2 Phase-wise Analysis of Variability in Agricultural Income in Andhra Pradesh:

Phases	**Phase –I (1960-1974)**	**Phase-II (1975-1988)**	**Phase-III (1989-2005)**
Growth Rate	2.01	2.76	2.80
Length of period	15	14	16
No. Cycles	5	3	5
Average Length of Cycle	3years	4.66years	3.4years
Average size of Amplitudes	645.15	469.87	614.42
GR of Maximum Points	7.41	-2.82	9.04
GR of minimum Points	2.85	-8.06	6.43
Nature of the Series in Phase	Divergent	Divergent	Divergent
Mean (in crore)	8938.24	11766.09	18330.92
Standard Deviation	1151.37	1682.01	2701.03
Coefficient of Variation	12.88	14.30	14.73

Note: When the growth rate of maximum points lesser than the growth rate of minimum points the series is called as "convergent". When the growth rate of maximum points higher than the growth rates of minimum points the series is called as "divergent".

The estimated CV and SD also witnessed the similar result. The CV in the third phase was highest in Andhra Pradesh. The CV in the first phase was 12.88, it increased to 14.30 and again in the third phase the CV increased to 14.73. Compared to the first phase, in the second phase the CV increased significantly where as the CV in the third phase witnessed slight change. The inference that derived from the above table is that the variability level was higher in the third phase compared to the second phase. The analysis of the variability in agricultural income shows that, Andhra Pradesh in the first phase witnessed low growth

and low variability. The second phase shows higher growth and a decline in the year to year fluctuation, whereas both the growth and fluctuation has increased in the third phase.

Orissa:

In Orissa, the total number of cycles in agricultural income series was 14. The number of cycles in agricultural income in the first phase and the last phase was the same. The second phase witnessed highest numbers of cycles in the agricultural income series. There were total 4 cycles in the first phase and the average occurrence of each cycle was 4 years. In the second phase the number of cycles increased to 6, thus the average occurrence of each cycle was 2.66 years. This implies that on an average in every 2.66 years one cycle occurs. In the third phase the total numbers of cycles was 4 and in every 3.5 years one cycle occurs in Orissa. Thus compared to the first and the third phase, the second phase in Orissa witnessed more number of cycles. The comparison of all the three phases shows that the first phase was the most stable phase compared to the rest. The second phase illustrated highest variation in the income series of Orissa. The average size of amplitudes was 423.43 in the first phase, it increased to 620.73 in the second phase and the size again declined to 464.71 in the third phase. The average size of amplitudes in the second phase was highest in the series. The growth rate of maximum and minimum points in the cycle is presented in the table: 5.3. The growth rate of maximum points was higher than the growth rate of minimum points in the first and the third phase. Thus the first and the third phase witnessed divergent trend in the agricultural income series. The growth rate of the maximum point was less than the growth rate of the minimum points in the second phase. Thus it witnessed a convergent series in the second phase.

Table: 5.3 Phase-wise Analysis of Variability in Agricultural Income in Orissa:

Phases	**(Phase-1)**	**(Phase-II)**	**(Phase-III)**

	1960-1975	1976-1991	1992-05
Growth Rates	2.29	1.72	0.26
Length of Period	16	16	14
No. Cycles	4	6	4
Average Length of Cycle	4year	2.66year	3.5years
Average size of Amplitudes	423.43	620.73	464.71
GR of Maximum Points	4.97	2.62	0.91
GR of minimum points	3.84	3.28	-6.44
Nature of the series in the phase	Divergent	Convergent	Divergent
Mean (in crore)	4316.74	5748.16	5886.30
Standard Deviation	566.39	846.60	542.80
Coefficient of Variation	12.89	14.73	9.49

Note: When the growth rate of maximum points is lesser than the growth rate of minimum points the series is called as "converging". When the growth rate of maximum points is higher than the growth rates of minimum points the series is called as "diverging".

The SD and the CV calculated for the agricultural income series was highest for the second phase. The CV has increased from the first phase (12.89) to the second phase (14.73), but it declined to 9.49 in the third phase. The above discussion about the variability indicates that the numbers of cycles, the size of amplitudes and also the CV was highest in the second phase. Thus the income from agriculture was highly fluctuating in the second phase in Orissa.

There was a decline in the growth rate of income from one phase to another in Orissa. The analysis of growth rates and the variability shows that the first phase shows highest growth and lower variation in the series. The second phase indicated declined growth rates compared to the first phase but highest variation in the series. In the third phase the growth rate as well as the variability was lowest. The third phase showed low growth and low variability.

The comparison of two states in regard to the variability in agricultural income shows that in the first phase the number of cycles in Andhra Pradesh was higher than the number of cycles in Orissa. The cyclical behavior of agricultural income in the second and third phase witnessed opposite trend. In the second phase, the number of cycles in Andhra Pradesh was less compared to the first phase but in Orissa the number of cycles increased compared to the earlier phase. Again in the third phase the number of cycles in Andhra Pradesh increased but in Orissa it declined. Thus the cyclical behavior in two states witnessed opposite trend;

where Andhra Pradesh witnessed increase in the cycles and amplitudes and Orissa witnessed decline in the cycles and amplitudes in the third phase compared to the second phase. The CV of the agricultural income in Andhra Pradesh has increased from one phase to another where as the CV of agricultural income declined in the third phase compared to the second in Orissa. Therefore, one finds that the cyclical movements of agricultural income shows opposite trend in the two states.

Section: V Co-movements of Factor Inputs with Agricultural Income in Andhra Pradesh:

The section attempts to study the co-movements between the factor inputs and agricultural income. The cyclical behaviour of each factor inputs was calculated for different phases in Andhra Pradesh. The correlation of the factors and the agricultural income is also studied in order to measure the co-movements of the inputs with agricultural income.

5.5.1 Co-movements of Factor Inputs with Agricultural Income in Andhra Pradesh in the First Phase (1960-61 to 1974-75):

The phase in Andhra Pradesh witnessed more number of cycles in agricultural income. In first phase, Andhra Pradesh witnessed intensive cultivation with increase in irrigation significantly in the form of canals and wells irrigation. There was limited increase in actual area under cultivation, only the area under double cropping showed increase with increase in area under oilseeds.

The cyclical pattern of the factor inputs showed that the amount of rainfall, land under cultivation and area irrigated by tank irrigation witnessed highest number of cycles (5 cycles each) in the first phase. Area under irrigation, area under paddy and cash crops each witnessed total 4 cycles in this phase. The income from non-agricultural sectors like industry and services illustrated less numbers of cycles in this phase. The income from tertiary sector did not witness any cycle in the first phase (Table: 5.4).

The variability of the factors leading to fluctuation in aggregate income is presented in the table: 5.4. The factors which shows high CV in the first phase are the area covered by well (20.30%) and tank irrigation (16.14). Other factors which witnessed higher instability above 10% were rainfall (14.79%), area under oilseeds (14.87%), area under cash crops (10.07%) and area sown more than once (14.72%). The factors which witnessed low CV were GCA (3.35%), NSA (2.36%), total net irrigated area (5.22%) and area under foodgrains (3.43%). The GCA and NSA both witnessed hardly any change in the first phase. The difference between year to year variations was low for land under cultivation.

Table: 5.4 Instability in Factors and the Co-movements with Agricultural Income in Andhra Pradesh in the First Phase:

Factors	Phases-I (1960-61 to 1974-1975)			
	Number of Cycles	Average size of Amplitudes	CV	Correlation with Agricultural Income
Industry	2	5126.00	19.50	0.75
Services	0	-	17.15	0.78
Rainfall	5	105.50	14.79	-0.06
GCA	5	351.60	3.35	0.62
NSA	5	282.90	2.36	0.53
ASMO	4	175.30	14.72	0.63
Irrigation	4	124.40	5.22	0.66
Canal Irrigation	2	60.00	8.55	0.66
Tank Irrigation	5	105.70	16.14	-0.28
Well Irrigation	3	25.00	20.30	0.79
Area Under Foodgrains	3	340.67	3.43	0.06
Area under Paddy	4	197.62	6.31	0.37
Area Under Oilseed	3	204.67	14.87	0.64
Area Under Cash Crops	4	61.13	10.07	0.72
Electricity consumption	2	16.50	59.42	0.71

The variability in area under tank irrigation depends on the amount of rainfall. The correlation between the two factors in the first phase was 0.70, thus the fluctuation in rainfall affects the fluctuations in tank irrigation. Moreover, the area under double cropping depends on irrigation. The correlation coefficient of area under double cropping and canal irrigation was 0.74. Thus fluctuation in the canal irrigation provision affects the cycles in the area cultivated. The increase in the cultivation of foodgrains especially rice depends on the increase in the gross cropped area and irrigation facility. The correlation between area under foodgrains and gross cropped area was 0.78 and the correlation with irrigation facility was 0.89, thus the cycles existing in any of these factors affects the cycles in the other factor. Cultivation of oilseeds also appears to be highly correlated with canal (0.82) and well

irrigation (0.82), implying that the fluctuation in irrigation led to the fluctuation in the land under oilseeds cultivation and vice versa (the correlation matrix of the variable are presented in the last chapter). This shows that the fluctuation of the factors affecting agricultural income are not independent to each other, the fluctuation in one factor also affects the other.

The important point to be noted is that the high variability of the factor inputs may not necessarily get reflected towards the variability in the income. The correlation between the factor inputs and the income from agriculture shows the co-movements of the factors. The higher variability of the aggregate income may be because of the increase in variability of a factor which has high correlation with agricultural income. The correlation coefficient of factor inputs with agricultural income is presented in the table: 5.4. The income from industry and services sector is highly correlated with the income from agricultural sector. Except rainfall and area under tank irrigation, all other factors witnessed positive correlation with agricultural income. The factors which witnessed high correlation with agricultural income were area under well irrigation (0.79) and area under cash crops (0.72). GCA (0.62), area under double cropping (0.63), net irrigated area (0.66), area under canal irrigation (0.66) and area under oilseeds (0.64) also witnessed high correlation with income. The correlation between area under foodgrains and net income from agriculture was very low.

The above analysis of fluctuation of the factors affecting income from agriculture and the co-movements of those factors with income shows that rainfall, gross cropped area, net sown area and area under tank irrigation witnessed highest number of cycles in the phase. But the correlation between income from agriculture with rainfall and tank irrigation was negative, implying that the variables do not move in a similar direction. Thus the high fluctuations in the traditional factors like rainfall or tank irrigation do not affect the fluctuation in income from agriculture. Gross cropped area witnessed comparatively higher correlation with income, implying the fact that the income cycles are influenced by the land cycles. Other factors like area under double cropping, total area irrigated and area under cash crops also witnessed higher correlation with income and also higher number of cycles. This shows that the cycles in these factors has an influence on the income originating from

agriculture. The correlation between income from non-agricultural sectors like industry and services were highly correlated with the income from agricultural sector, proving the fact that the fluctuation in the income from out side agriculture affects the fluctuation in the agricultural income.

5.5.2 Co-movements of Factor Inputs with Agricultural Income in Andhra Pradesh in the Second Phase (1975-76 to 1988-89):

The second phase in Andhra Pradesh from 1975-76 to 1988-89, witnessed less number of cycles in agricultural income compared to the number of cycles in the first phase. The second phase in Andhra Pradesh can be called as a green revolution led growth process. In this phase the total aggregate income increased and also the utilization of modern inputs.

The cyclical behavior of the factors shows that the area under tank irrigation (6 cycles), area under paddy cultivation (6 cycles) and total area irrigated (5 cycles) showed highest number of cycles in the phase. Each of the variables like amount of rainfall, canal irrigation, area under foodgrains and area under HYVs witnessed 4 cycles. The number of cycles for all the above three variables has increased in the second phase compared to the first phase. The income from the industry witnessed only one cycle where as the income from services sector exhibited no cycles. The average size of amplitudes of the factors is also presented in the table: 5.5, it shows the increase or decrease in the average height of the cycles. Increase in the average size of amplitudes of the factor implies the increase in variability of the series. Rainfall, area under gross cropped and net sown, area under tank irrigation and area under foodgrains witnessed increase in the length of amplitudes in the second phase compared to the first phase, implying the cycles for those factors became sharper in this phase. Even if the number of cycles increased for net irrigated area compared to the first phase, the average size of amplitudes has declined. It shows that the size of cycles reduced in the second phase compared to the first phase. The land under oilseeds and cash crops witnessed decline in the number of cycles as well as in the average size of the amplitudes. The income from industrial sector witnessed decline in the number of cycles but increase in the average size of amplitudes.

The coefficient of variation of almost all the factors has increased in this phase compared to the first phase. Except for the CV of area under double cropping, area under canal and well irrigation, the CV of all other factors has increased in the second phase than in the first phase. The factors that witnessed high instability were fertilizer consumption (37.42%) and electricity consumption (68.79%). Also the CV of rainfall (15.97%), area under tank (17.39%) and well irrigation (16.81%), area under oilseeds (18.93%) and cash crops (19.69%) and area under HYVs seeds (13.79%) was quite high in this phase.

Table: 5.5 Instability in Factors and the Co-movements with Agricultural Income in Andhra Pradesh in the Second Phase:

Factors	Phases-II (1975-76 to 1988-89)			
	Number of Cycles	Average size of Amplitudes	CV	Correlation with Agricultural Income
Industry	1	3585.12	23.15	0.87
Services	0	-	30.87	0.84
Rainfall	4	153.50	15.97	0.17
GCA	3	469.67	4.09	0.50
NSA	3	416.00	3.70	0.26
ASMO	3	90.70	11.03	0.79
Irrigation	5	97.30	6.86	0.73
Canal Irrigation	4	38.50	5.01	0.76
Tank Irrigation	6	143.17	17.39	-0.002
Well Irrigation	0	-	16.81	0.80
Area Under Foodgrains	4	492.50	8.12	-0.36
Area under Paddy	6	149.60	6.99	0.43
Area Under Oilseed	2	34.50	18.93	0.85
Area Under Cash Crops	3	40.50	19.69	0.79
Area under HYVs	4	93.92	13.79	0.84
Fertilizer	2	39.90	37.42	0.82
Electricity consumption	0	-	68.79	0.62

The modern inputs are dependent on a set of other factors for its success, thus the fluctuation in the modern inputs may be a mixture of the fluctuation in other factors. Modern inputs like per hectare use of fertilizer and area under HYV seeds need irrigation for better results. Area under canal and well irrigation was highly correlated with area under HYV seeds and fertilizer consumption (range between 0.76 to 0.96). But the provision of irrigation itself witnessed cycles, thus the cycles in irrigation in turn get added with the cycles in modern inputs. Again the cultivation of the oilseeds and cash crops needs irrigation and fertilizer.

Thus the correlation between area under oilseeds and cash crops with area under well irrigation, consumption of fertilizer and area under HYV seeds was high.

The co-movements of the factors affecting the income from agriculture in the second phase are presented in the table: 5.5. The table shows that except area under tank irrigation (-0.002) and area under foodgrains (-0.36), all other variables witnessed positive correlation with income. The correlation of all the variables with income has increased in the second phase compared to the first. The factors which witnessed high correlation with income were income from non-agricultural sector, area under HYVs seeds (0.84), fertilizer consumption (0.82), area under oilseeds (0.83), area under well irrigation (0.80), area under cash crops 0.79), area under double cropping (0.79), area under canal irrigation (0.76) and net irrigated area (0.73). Thus the above factors and income from agriculture moved in a similar direction. It implies that the fluctuation in any of the factors leads to the fluctuation in the income from agriculture in the second phase.

The relationship between the fluctuation of the factors and income from agriculture can be studied by the co-movements of the factors. Area under HYVs and area irrigated canals witnessed highest number of cycles as well as high correlation with income from agriculture, thus the cyclical behavior in the above factors affect the cyclical pattern in the income series. The modern inputs, irrigation by wells and canals, area under oilseeds, cash crops and income from non- agricultural sector witnessed higher correlation with income from agriculture. Thus, correspondingly the cycles in these factors would influence the fluctuation in the income from agriculture. The increase in the number of cycles and the amplitudes for area under paddy and area under tank irrigation may not get reflected in the total income as the correlation of these factors with income has declined.

The instability (CV) of income from industry and service sector, modern inputs, fertilizer consumption and area under cash crops was high in the second phase. The correlation of these factors with income from agriculture was also high, thus the increased CV in the second phase was the reflection of the higher CV in the above mentioned factors. The

correlation of the income with land under cultivation and rainfall was low, so the instability in these factors did not influence the instability in the income.

5.5.3 Co-movements of Factor Inputs with Agricultural Income in Andhra Pradesh in the Third Phase (1989-90 to 2005-06):

The third phase in Andhra Pradesh starts from 1989-90 and ends by 2005-06. The agricultural economy in Andhra Pradesh represents a structure allowing for the diversification towards market oriented crops and private initiative in agriculture. The increase in well irrigation and fertilizer consumption showed the importance of private initiative agriculture. The instability of income was highest in this phase compared to first and second phase.

The fluctuations of the factor inputs shows that rainfall (6 cycles), GCA (5 cycles), area sown more than once (5 cycles), area under foodgrains (5 cycles), oilseeds (5 cycles) and cash crops (5 cycles) illustrated highest number of cycles among all inputs in the phase. The number of cycles of the above variables has increased in the third phase compared to the second phase. The cyclical behavior of the inputs is correlated with each other. Area under well irrigation, area under cash crop and fertilizer uses are correlated among themselves, thus the fluctuation in one these above variables would lead to the fluctuation in the other. Again area under foodgrains was highly correlated with canal irrigation, tank irrigation and NSA, thus higher cycles witnessed in the former may influence the latter. The income from services sector witnessed a smooth trend without any cycles. Income from industry and electricity consumption showed one cycle each. Along with the increase in the number of cycles the amplitudes of almost all the factors has also increased in this phase compared to the second phase, except for the average size of amplitudes in well irrigation and gross cropped area. The modern inputs like area under HYV seeds and fertilizer consumption witnessed higher number of cycles in this phase and the average size of amplitudes also increased. It shows that the distance between the maximum and minimum points was widened in this phase compared to the second phase.

The instability (CV) of almost all the factors, declined in the third phase compared to the second phase. The CV was highest for tank irrigation (25.91%) and electricity consumption (24.58%). Factors like area under well irrigation (14.57%), area under paddy (12.12%), area under cash crops (18.64%), fertilizer consumption (10.81%) and rainfall (1451%) also witnessed higher CV. The factors which observed CV below 10 percent were area under GCA (4.01%), NSA (4.04%), area sown more than once (7.78%), total area under irrigation (6.85%), area under foodgrains (6.96%), area under oilseeds (9.41%) and area under HYV seeds (8.97%).

Table: 5.6 Instability in Factors and the Co-movements with Agricultural Income in Andhra Pradesh in the Third Phase:

Factors	Phases-III (1988-89 to 2005-06)			
	Number of Cycles	Average size of Amplitude	CV	Correlation with Agricultural Income
Industry	1	44773.50	26.70	0.79
Services	0	-	31.37	0.83
Rainfall	6	117.16	14.51	0.14
GCA	5	416.20	4.01	-0.14
NSA	4	446.63	4.04	-0.15
ASMO	5	111.21	7.78	0.12
Irrigation	4	247.50	6.85	-0.03
Canal Irrigation	3	158.83	13.06	-0.67
Tank Irrigation	4	96.25	25.91	-0.62
Well Irrigation	2	38.75	14.57	0.89
Area Under Foodgrains	5	373.30	6.96	-0.38
Area under Paddy	4	352.50	12.12	0.01
Area Under Oilseed	5	149.50	9.41	-0.43
Area Under Cash Crops	5	90.00	18.64	0.81
Area under HYVs	4	367.38	8.97	-0.17
Fertilizer	3	113.60	10.81	0.88
Electricity consumption	1	1773.28	24.58	0.78

The causation of instability of the factor inputs and income are studied using correlation coefficient. Almost all the factors witnessed negative correlation with income in the third phase except for area under double cropping, area under well irrigation, area under cash crops, fertilizer consumption and electricity consumption. The correlation between area under well irrigation and income was highest (0.89). The correlation between area under cash crops (0.81), fertilizer uses (0.88) and electricity consumption (0.78) with income was also high. The correlation between income and fertilizer increased in the third phase

compared to the second phase. There was a decline in the growth rate of area under foodgrains and oilseeds but an increase in the growth rate of agricultural income i.e. the correlation between income with area under foodgrains and oilseeds was negative. Area under HYVs illustrated negative correlation with income from agriculture, this might be due to the fact that HYVs were mainly provided for the food crops and the decline in the area under foodgrains led to the negative correlation.

The factors which witnessed higher numbers of cycles were GCA, area sown more than once and all the category of crop cultivation. But except area under cash crops, all other factors witnessed negative and low correlation with agricultural income. Thus the cyclical pattern in the area under cash crops affects the agricultural income of the states. The number of cycles in consumption of fertilizer, electricity uses and area under well irrigation declined in the third phase compared to the second. On the other hand the correlation of those factors with income was high. This implies that the cyclical pattern in the above factors also affects the cyclical pattern of income from agriculture. The correlation of agricultural income with the income from services sector was high in the phase. Thus it can be obtained from the above analysis that the number of cycles present at the aggregate level was generated by the cycles in fertilizer consumption, area under cash crops, well irrigation, consumption of electricity and income from service sector.

The CV of the inputs like well irrigation, fertilizer consumption and area under cash crops was high in the third phase. Irrigation through tanks also witnessed higher CV but the correlation of the factor with income was negative. In the third phase all the inputs witnessed decline in the correlation with income except for well irrigation, fertilizer consumption, area under cash crops and electricity consumption in agriculture. In fact correlation of these factors with income has increased in the third phase compared to the second phase. Thus the instability in income primarily gets generated by the instability in the above mentioned factors.

Section: VI Co-Movements of Factor Inputs with Agricultural Income in Orissa:

The present section attempts to study the co-movements between the factor inputs and agricultural income in the state of Orissa. The phase-wise analysis of the cyclical pattern in the factors with agricultural income is presented in this section.

5.6.1 Co-Movements of Factor Inputs with Agricultural Income in Orissa in the First Phase (1960-61 to 1975-76):

The first phase in Orissa starts from 1960-61 and ends by 1975-76, which is characterized as an intensive phase with increase in irrigation in terms of canal irrigation. There was a decline in area under paddy production and an increase in area under inferior cereals in the state and also a shift from cash crops towards foodgrains production. The first phase in Orissa witnessed less number of cycles and comparatively stable than the second and the third phase.

The cyclical behavior of the variables shows that the area under foodgrains and paddy witnessed highest number of cycles. Total land under cultivation and area under oilseeds and cash crops also illustrated higher number cycles in the first phase (6 cycles each). Amount of rainfall illustrated 5 cycles in the first phase whereas land under cultivation, area under oilseeds and cash crops witnessed 4 cycles each. The income from industry showed 2 cycles and income from services showed 3 cycles in the phase.

The factor showing high instability (CV) is area under lift irrigation i.e. around 92%[2]. Other factors which showed higher CV in this phase were area under double cropping (42.54%), area under major irrigation (26.13%) and other irrigation sources (26.89%) and area under oilseeds (22.26%). The area under double cropping was highly unstable in Orissa[3]. Land

[2] Area under lift irrigation was almost negligible at the starting of the phase, the high variability may be due to sudden increase in the provision of lift irrigation facility after 1970s. Thus the deviation from the trend was high.

[3] in 1966-67 total 1936 thousand hectare was under double cropping and in 1967-68 it came down to 313 thousand hectare.

under cultivation depends upon either rainfall or the extent of irrigation. Land under net irrigated area, major and lift irrigation sources were highly variable in this phase.

Table: 5.7 Instability in Factors and the Co-movements with Agricultural Income in Orissa in the First Phase:

Factors	Phases-I (1960-61 to 1975-76)			
	Cycles	Amplitude	CV	Correlation with NSDP
Industry	2	11041.50	12.78	0.32
Services	3	3158..33	11.63	0.86
Rainfall	5	195.06	17.30	0.18
GCA	4	312.75	7.12	0.38
NSA	4	143.75	2.73	0.11
ASMO	4	242.37	42.54	0.36
Irrigation	2	22.18	19.08	0.78
Major Irrigation	0	-	26.13	0.79
Flow Irrigation	1	5.78	18.10	0.77
Lift Irrigation	3	1.72	92.24	0.31
Other Irrigation	3	46.44	26.89	0.32
Area under Foodgrains	6	94.44	9.42	0.78
Area under Paddy	6	90.10	5.67	0.77
Area under Oilseeds	4	18.77	22.26	0.75
Area under Cash Crops	4	7.53	16.64	0.60

The factors affecting the agricultural income were also correlated among themselves, thus the fluctuation in one variable affecting the other variable. Area under foodgrains in the first phase was highly correlated with major (0.87) and flow (0.88) irrigations, thus the irrigation facility also affects the fluctuation in the area under foodgrains. Again the cultivation of foodgrains, oilseeds and cash crops were highly correlated with major and flow irrigation sources. The cropping pattern of the states shows that the area cultivated under foodgrains was highly correlated with area under oilseeds and cash crops, implying that the fluctuation in the area under any of the crops affect the other. Thus the factors are interrelated with each other and fluctuation in one variable affects the other.

The relationship of the factor inputs with income is presented with correlation coefficient. The correlation of aggregate income with the factors like income from services sector (0.82), area under major irrigation (0.79) and flow irrigation (0.77), area under foodgrains (0.78), area under oilseeds (0.75) was highest in the phase. This shows that all the above inputs and income level move in a similar direction. The inputs which witnessed low correlation with

income were net sown area (0.11), amount of rainfall (0.18). The correlation of income from agriculture with gross cropped area, area sown more than once, area irrigated by lift and other irrigation sources was insignificant. This shows that land under cultivation and income did not show similar trend.

The analysis of cyclical pattern of the factor inputs and the correlation of those factors with income shows that the area under foodgrains and paddy, witnessed highest number of cycles as well as high correlation with income, implying that the fluctuation in area under foodgrains led to the fluctuation in income. Area under total irrigation, major and flow irrigation were highly correlated with agricultural income, but the cycles in the series are comparative low. Thus the less number of cycles at the aggregate level may be because of the less number of cycles existing in the factors which are highly correlated with income. Income from services is also highly correlated with agricultural income.

The CV for area sown more than once, major, flow and lift irrigation and area under oilseeds was high. The variability on area under double cropping was high but its correlation with income was low thus one can interpret that the instability in income was not dominantly due to the high instability in area sown more than once. The instability level was highest for lift irrigation compared to all other irrigation system, but its correlation with income from agriculture was low. Thus the higher instability in the series may not get reflected in the instability in the income.

5.6.2 Co-movements of Factor Inputs with Agricultural Income in Orissa in the Second Phase:

The second phase starts from 1976-77 and ends at 1991-92. The second phase in Orissa agriculture did not witness any substitution of land based production system towards technology or capital based production process. Expansion of land under cultivation played an important role in defining the production process in Orissa. There was significant increase in the area under paddy cultivation. The number of cycles in the aggregate income was the highest in this phase compared to the other phases. The CV in the agricultural

income has also increased in the second phase to 14.73% compared to the instability level in the first phase (12.84%).

The number of cycles pertaining to each factor increased in the second phase compared to the first phase. Rainfall, land under cultivation, area under cash crops witnessed highest number of cycles in the second phase (6 cycles each). The number of cycles in the income from industry, area under foodgrains was also high (5 cycles each). Total irrigation and area under oilseeds witnessed less number of cycles in the phase. Along with the increase in the number of cycles, the amplitudes of the cycles has also increased. Except the different categories of land under cultivation, all the other factors witnessed increase in the average size of amplitude in the second phase compared to the first phase. The different sources of irrigation witnessed increase in the number of cycles and also increase in the average size of amplitudes in the second phase. Thus it shows that in the second phase, the average size of the cycles has increased compared to the first. All the factor inputs in the second phase are highly correlated with each other. Area under HYV seeds showed correlation with gross cropped area, area sown more than once, irrigation by major, lift and flow, area under oilseeds area under foodgrains and consumption of fertilizer. Thus the fluctuation in any of the one variable led to the fluctuation in the other variable.

In the second phase, new technology was introduced in the agricultural field and the instability of the modern technologies was high. The variability of area under HYV seeds, fertilizer consumption and electricity consumption was 37.36%, 42.55% and 67.81% respectively. Along with the modern inputs, lift irrigation and other sources of irrigation also witnessed higher variability. The CV for net sown area, gross cropped area, area under foodgrains and area under cash crops was low.

Table: 5.8 Instability in Factors and the Co-movements with Agricultural Income in Orissa in the Second Phase:

Factors	Phases-II (1975-76 to 1988-89)			
	Cycles	Average size of Amplitudes	CV	Correlation with Agricultural Income
Industry	5	11136.50	21.77	0.36
Services	3	4869.67	26.50	0.65
Rainfall	6	152.58	17.31	0.40
GCA	5	190.60	7.82	0.65
NSA	6	91.67	2.64	0.71
ASMO	4	202.00	21.01	0.60
Irrigation	2	54.05	13.74	0.49
Major Irrigation	1	33.97	11.05	0.47
Flow Irrigation	3	9.48	13.11	0.51
Lift Irrigation	4	6.86	99.10	0.46
Other Irrigation	3	32.99	42.66	0.65
Area under Foodgrains	5	200.88	4.77	0.67
Area under Paddy	5	92.70	3.24	0.39
Area under Oilseeds	2	41.31	24.40	0.58
Area under Cash Crops	6	7.74	9.28	-0.02
Area under HYVs	3	36.59	37.36	0.51
Fertilizer	3	3.82	42.55	0.60
Electricity consumption	2	19.75	67.81	0.34

The relationship of the variability in agricultural income with factor inputs is presented with level of the correlation between them. The correlation among the inputs and income declined in the second phase compared to the first. The correlation between income and net sown area was highest in this phase (0.71). This implies that the increase in the area under cultivation led to increase in the aggregate income. Other factors like gross cropped area (0.65), area under double cropping (0.60), irrigation by other sources[4] (0.65), area under foodgrains (0.67) and fertilizer consumption (0.60) illustrated high correlation with income. The correlation between rainfall, electricity consumption and irrigation through major and lift irrigation sources was comparatively low with income i.e. 0.40, 0.34, 0.49 and 0.47 respectively.

The number of cycles increased in this phase compared to first phase. Almost all the factor inputs in the second phase were correlated with each other. But the correlation of those inputs with the aggregate income was not very high in the phase. The correlation of

[4] Other irrigation sources in Orissa includes irrigation through ponds, rivers and other traditional private sources.

agricultural income with modern inputs like area under fertilizer consumption and area under HYV seeds was not high. Among all the factors only net sown area witnessed high correlation with income, thus the fluctuation in aggregated income in the second phase was primarily generated by the fluctuation in the land under cultivation. The number of cycles exising in the series of net sown area was high leading to high number of cycles in the series generating the cycles in the aggregate income. This implies that the cycles exist in the factors like land under cultivation, and area under foodgrains leading to the fluctuation in the income level in the phase.

The CV of the use of modern inputs was high in this phase. With the increase in importance of the modern inputs, one can expect the fluctuation in modern inputs will lead to the fluctuation in the agricultural income. But the correlation between these factors with income was not impressive in Orissa like Andhra Pradesh. Factors like area under other irrigation sources, area under double cropping and fertilizer consumption demonstrated higher CV and relatively high correlation with income in this phase. It can be inferred that the variability in the above factors dominantly affect the variability in income.

5.6.3 Co-movements of Factor Inputs with Agricultural Income in Orissa in the Third Phase:

The third phase in Orissa starts from 1992-93 and ends by 2005-06. The growth rate of agricultural income as well as the instability in agricultural income (9.49%) declined in this phase and it was also lowest compared to other periods. The third phase in Orissa witnessed land based economic system where the importance of rainfall was high.

Area under foodgrains, especially paddy and amount rainfall witnessed highest number of cycles in the third phase. Land under cultivation, area under lift irrigation, area under HYV seeds and income from non-agricultural sector like industry, also illustrated more number of cycles in the phase (table: 5.9). The number of cycles exist in all most all the variables has declined in the phase. The average size of amplitudes of the amount of rainfall and gross cropped area increased in the phase. Amount of rainfall, GCA, area sown more than once,

irrigation sources, area under oilseeds and modern inputs witnessed either declined or same number of cycles in this phase compared to the second phase, but the average size of amplitudes increased in the phase compared to the second. Thus even if the number of cycles had declined, the size of the amplitudes increased in this phase. Area under foodgrains and paddy witnessed highest number of cycles in this phase, but on the contrary the average size of amplitude was lower in the phase compared to the second phase.

Among all the inputs, the CV of electricity consumption (40.97%), fertilizer uses (20.52%), area under double cropping (17.38%) and amount of rainfall (17.85%) was high in this phase. All the other inputs witnessed decline in the instability level in the third phase compared to the earlier period except the variability in area under cash crops.

Table: 5.9 Instability in Factors and the Co-movements with Agricultural Income in Orissa in the Third Phase:

Factors	Phase-III (1989-90 to 2005-06)			
	Cycles	Average size of Amplitude	CV	Correlation with Agricultural Income
Industry	4	18960.23	24.17	-0.80
Services	0	-	30.32	-0.65
Rainfall	5	214.18	17.85	0.76
GCA	4	423.87	8.44	0.06
NSA	2	76.00	3.84	0.08
ASMO	4	271.12	17.38	0.51
Irrigation	3	39.50	5.90	0.10
Major Irrigation	0	-	8.56	0.09
Flow Irrigation	1	4.50	7.87	0.21
Lift Irrigation	4	7.13	8.23	0.19
Other Irrigation	1	83.95	11.65	-0.30
Area under Foodgrains	6	198.95	7.06	0.14
Area under Paddy	6	51.16	1.60	0.54
Area under Oilseeds	2	176.29	14.17	0.28
Area under Cash Crops	3	7.58	20.12	0.21
Area under HYVs	4	83.36	6.52	0.20
Fertilizer	2	23.71	20.52	0.14
Electricity consumption	2	105.15	40.97	0.20

The correlation of factor inputs with aggregate income has declined significantly in this phase compared to earlier phases. The correlation between income and amount rainfall was 0.76. The correlation between area under double cropping and agricultural income was 0.51. All the other factors witnessed low correlation with income. The correlation between area

under HYV seeds, fertilizer consumption and electricity consumption with income from agriculture was low. Except rainfall, none of the inputs witnessed high correlation with income in the third phase. Thus the cycles in the exogenous factor like rainfall get reflected as the cycles in the aggregate income. It can be inferred from the above table that the decline in instability level of net income from agriculture in the third phase may be due to declined fluctuation in all the inputs and the fluctuation level in the phase was only influenced by the rainfall. The cycles in the amount of rainfall remained constant through out the phases.

Section: VII Conclusion:

The analysis of the cyclical behaviour pattern of the agricultural income in two states shows that Andhra Pradesh agricultural income witnessed less number of cycles compared to Orissa in the whole period. But the average size of amplitudes in Andhra Pradesh was higher. The phase wise analysis of the cycles in agricultural income in Andhra Pradesh shows that the number of cycles and the size of amplitudes were high in the first phase compared to the second phase. The number of cycles of agricultural income in Andhra Pradesh declined in the second phase. The third phase witnessed increase in the number of cycles with the increase in size of amplitudes. In Orissa, the first phase and the third phase witnessed lower number of cycles in agricultural income compared to the second phase. The number of cycles in the second phase was highest with an increase in the size of amplitudes. This shows that the cyclical behavior pattern in two states is different over the phases.

The analysis of the factors affecting the cycles in agricultural income in two states shows that the nature of generation of the cycles is different in two states depending on the structure of the economy. In Andhra Pradesh, the factors that influence the cyclical fluctuation in the agricultural income changed from one phase to another. In the first phase, mainly area under irrigation, area under cash crops and the land cultivated witnessed significant influence on the fluctuation in the aggregate income. The cycles in the modern inputs like area under HYV seeds, fertilizer and the land under well irrigation, led to the cycles in the income at the second and the third phase. On the contrary, in Orissa in the first phase, the factors which contribute towards the variability in the agricultural income were

mainly irrigation and the area under paddy and foodgrains. In the second phase, there was increase in the use of modern inputs but the co-movements of those factors with the agricultural income were not significant. In the second phase, land under cultivation and the area under foodgrains were the factors that influenced the cycles in the agricultural income. In the third phase, the co-movements of all most all the factors with the agricultural income declined. Rainfall was the only factor which witnessed high co-movements with the cycles in the agricultural income for Orissa. Thus the factors contributing to the generation of cycles in Orissa were mainly land and nature related factors. With the process of transformation, the state of Orissa did not witness shift from the traditional economy towards the modern economy structure. However, in Andhra Pradesh there was a shift from the traditional factors influencing the cycles towards the modern inputs over the phases.

Chapter: VI

CONCLUSION

The study has attempted to analyze one of the puzzles on the performance of Indian agriculture, why states do perform differently in the post independence period. The received literature identifies four set of factors that influence the agricultural performance. The factors are like natural factors, state policies with respect to provision of inputs and output and 'history matters' in terms of land settlement introduced in the colonial period. In addition to the above factors, this work attempts to propose that the structure of the state economy also matters. Here structure is identified in terms of incomplete transformation of the economy and by implication non-dominance of market structure in the economy. Even under conditions of incomplete transformation of the Indian economy, the states are not similar in terms of the relative importance of market economy. Some states may have a relatively more dominant market economy when compared to other states. So the economies with a relatively more dominant market economy may be able to perform better (in terms of growth of output) when compared to economy with a relatively less important role for the market economy. Studies on the performance of the Indian states do not explicitly bring out the structural differences as an explanatory variable into their analysis. This work attempts to bring the structure of the economy as an important feature of analysis.

The method used in the study to capture the influence of structure on the performance is from the side of effect. Agricultural performances of the two states were studied and the cause for the differential performances is attributed to the difference in the structure of the economy. Thus there is a link from the effect to the cause.

In a market oriented structure the performance of the agrarian economy is largely determined by crop diversification towards high valued crops due to specialization and division of labor (demand side factor) and introduction of modern inputs into the production process (supply side factors). In such an economy the performance i.e., growth as well as cyclical behaviour of income originating from agriculture is determined by these factors. While in a traditional economy the performance of the economy gets determined by natural factors as well as the land under cultivation. Under conditions of incomplete transformation,

states with relatively more dominance the market economy will have its performance determined by crop diversification and the use of modern inputs. However the states with dominance of traditional economy will have nature and land under cultivation being the important decisive variables for the performance of economy. The study considers two states, namely Orissa and Andhra Pradesh for analysis.

The structure can introduce constraints to the agents to expand the production by constraining the demand that exists or by introducing constraint to the supply of goods by the agent. The supply side problem arises in an economy by the structure when an agent has an incentive problem since they have feelings that they will not able to appropriate the result from the expended production and so may not expand production. The study identified three type of supply-side constraint faced by the agent. The land settlement process introduced by the colonial state for the state of Andhra Pradesh are more conducive for the appropriation of increases in the output when compared to Orissa due to the higher proportion of land under ryotwari settlements and relatively more successful implementation of land reforms measures. The proportion of tribal population (who are largely semi-closed to external influnces) is less for the state of Andhra Pradesh when compared to Orissa. Andhra Pradesh also has lower proportion of non-workers when compared to Orissa.

A demand side constraint is introduced by the structure when the agent does not want to expand the production because of lack of demand in the system. In Andhra Pradesh, the share of the small farmers was higher than in Orissa. The allocation of labour in the different sectors of the economy can also lead the demand side constraint. With the process of development one would expect the change in composition of labour as well as output. When the share of labour engaged in industry sector is high, that can lead to migration of labour from agriculture to industry which in turn leads to increase in demand for goods and services. The share of workers engaged in the industry and services sector was much higher in Andhra Pradesh compared to Orissa.

The structures of the two economics are different both from the demand side as well as form the supply side. But if one compares the two structures, it shows that the structure of Andhra Pradesh economy is more conducive for growth when compared to Orissa economy.

The agricultural performance of the two economies was studied by taking agricultural income as the main indicator. The growth rate of agricultural income was higher in Andhra Pradesh than Orissa. The whole period of analysis is divided into three different phases. Over the three phases the growth rate of agricultural income witnessed an increasing trend for Andhra Pradesh. But the growth rate of agricultural income declined from the first phase to the third phase in Orissa. The first structural break for agricultural income for Andhra Pradesh (1975-76) coincided with a break in the index number of yield. The second break for Andhra Pradesh (1988-89) coincided with a break in the index number of crop diversification. In the case of Orissa, the nature of generation of break points was different from that of Andhra Pradesh. The first structural break point of agricultural income in Orissa (1976-77) coincided with a break in index number of land under cultivation. The second break for Orissa (1991-92) coincided with breaks in index of area, yield as well as towards specialization of crop production. The factors accounting for structural breaks in Andhra Pradesh are due to yield increase and crop diversification while in Orissa land continues to be the main factor accounting for breaks.

The next exercise in the work is to account for growth in the different phases. The first phase in Andhra Pradesh witnessed intensive method of cultivation with increase in area under irrigation and expansion of the double cropping area. There was no significant increase in the actual area under cultivation in the first phase but area under double cropping witnessed increasing trend. The first phase also witnessed the diversification from inferior crop cultivation towards the superior crops like rice and oilseeds. In the second phase there was a shift in the importance towards uses of modern inputs and irrigation through wells in Andhra Pradesh. The second phase in Andhra Pradesh can be termed as the ‘modern inputs led phase’ that led to the increase in the growth rate of aggregate income. The diversification of crops from foodgrains towards oilseeds and cash crops was higher in the second phase. The third phase in Andhra Pradesh witnessed sharp decline in the area under total foodgrains including paddy and an increase in the area under oilseeds and cash crops. The growth rate

of the area under cash crops was higher in the phase. The diversification towards market oriented crops implied the increase in the private initiative in the state. The use of fertilizer and well irrigation were the factors influencing the aggregate income in the third phase.

Orissa agricultural economy witnessed increase in the major and lift irrigation sources in the first phase. The area under paddy declined in this phase with an increase in the area under pulses and inferior crops. At the aggregate level all the category of crops witnessed increase in the area under cultivation with sharp decline in the area under vegetable and other crops. Thus the factors influencing the aggregate income in the initial period were area under gross cropped, land under major irrigation sources and exogenous factor like rainfall. In the second phase there was expansion in gross cropped area with an increase in area under double cropping. Even though the use of HYV seeds and fertilizer was high in this phase , the area under rice and cash crops declined and area under pulses and oilseeds increased. The factors that highly influenced the aggregate income were gross cropped area, net sown area and area under paddy. This shows that the second phase in Orissa did not witness any shift from the 'area led growth' towards the 'modern inputs led growth' process. Even if the growth rate of the utilization of modern inputs increased, its realization towards the output was negligible. Thus the aggregate income from agriculture was very low in the second phase. The third phase witnessed decline in the area under cultivation and increase in the area under lift irrigation. There was significant increase in the share of land under paddy and decline in the share of land under oilseeds. Thus, the factors like area under double cropping, area under paddy and rainfall were the defining factors for the decline in the income in the third phase.

In the process of accounting for growth in each phase, Andhra Pradesh witnessed that the importance of land as a source of growth is declining and the importance modern inputs and crop diversification takes a central role. But in the case of Orissa, the importance of land and natural factors continue to play an important role.

The third aspect being studied is the short run fluctuations and the sources of short run fluctuations of income originating from agriculture. The sources of fluctuation in production or income can be different from one set of economic system to another. Different economic

systems may have different combination of production structure thus generating different types of cyclical behavior pattern in the growth process. In a modern economy there is increase in use of the modern inputs for the production process and market interactions increases. Thus in this type of economy the cycles in the aggregate income series is generated by modern inputs. On the other hand, the economy with the dominance of the traditional production system witnessed the importance of the traditional factors like land and rainfall for the generation of the cycles. The co-movement of the variability in agricultural income and the factor inputs is analysed in the study.

The sources of the short run fluctuations in agricultural income for Orissa were mainly land under cultivation, area under foodgrains and rainfall in all the three phases. Thus in the case of Orissa, the co-movements of the cycles in land and the natural factors lead to fluctuations in agricultural income. In Andhra Pradesh the factors which witnessed higher impact on the fluctuation in the agricultural income has changed from one phase to another. In the first phase mainly area under irrigation, area under cash crops and the land cultivated witnessed significant influence towards the fluctuation in the aggregate income. The cycles existing in the use of modern inputs explained the fluctuation in the income at the second and the third phase. In Andhra Pradesh, over the time period, the co-movements of the modern inputs with agricultural income has increased compared to the natural factors.

The two agrarian economics have different structures with the structure in Andhra Pradesh more conducive for growth when compared to orissa. The performance of the Andhra Pradesh agrarian economy seems to have moved out of the 'land constrained' system and is more responsive to the application of modern inputs as well as to diversification towards market oriented crops with private initiative playing a role. However, the performance of Orissa agrarian economy continues to be 'land constrained'. To conclude, the study finds that the initial structure as well as the evolving structure of the two states is different in terms of the growth and fluctuations. Therefore, the state level comparison of the performance of the agriculture sector depends on the structure of the particular state economy. Hence, the present study concludes that to analyse the performance of the economy, the structure of the economy needs to be studied.

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