A STUDY ON THE GROWTH AND DEVELOPMENT OF ORISSA'S AGRICULTURE: Implication for accelerated agricultural development

A
THESIS
SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY, BHUBANESWAR

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF

MASTER OF SCIENCE IN AGRICULTURE
(AGRICULTURAL ECONOMICS)

BY
Malla Prasanthi

DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE
ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
BHUBANESWAR-751 003, ORISSA

2008

THESIS ADVISOR **Dr. D. C. Pradhan**

Dedicated
To My Beloved Father

Orissa University of Agriculture and Technology

Bhubaneswar – 751 003, ORISSA

Dr. D.C. Pradhan, Ph.D. (UAS)
Associate Professor,
Department of Agricultural Economics,
College of Agriculture,
Orissa University of Agriculture and Technology,
Bhubaneswar – 751 003.

CERTIFICATE

This is to certify that the research work recorded in the thesis entitled **"A STUDY ON GROWTH AND DEVELOPMENT OF ORISSA'S AGRICULTURE: IMPLICATION FOR ACCELERATED AGRICULTURAL DEVELOPMENT"** submitted in partial fulfillment of the requirement for the award of the degree of **MASTER OF SCIENCE IN AGRICULTURE (AGRICULTURAL ECONOMICS)** of the Orissa University of Agriculture and Technology, Bhubaneswar is an authentic record of bonafide research work carried out by **Prasanthi Malla** under my direct supervision and guidance. The results of investigation reported in this thesis have not so far been submitted for any other degree or diploma. The assistance and help received during the course of the investigation and sources of literature have been duly acknowledged.

D.C. Pradhan
30/08/08

Bhubaneswar
Date : 30/08/08

(Dr. D.C. Pradhan)

Chairman
Advisory Committee

APPROVAL SHEET

A STUDY ON GROWTH AND DEVELOPMENT OF ORISSA'S AGRICULTURE: IMPLICATION FOR ACCELERATED AGRICULTURAL DEVELOPMENT

A THESIS SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, BHUBANESWAR

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN AGRICULTURE
(AGRICULTURAL ECONOMICS)
2008

By
Prasanthi Malla

Approved by Advisory Committee

D.C. Pradhan. 3/10/08

Chairman : **Dr. D.C. Pradhan, Ph.D. (UAS)**
Associate Professor,
Department of Agricultural Economics
College of Agriculture,
OUAT, Bhubaneswar – 751 003.

MEMBERS

03-10-08

Dr. H.N. Atibudhi
Professor and Head
Department of Agricultural Economics
College of Agriculture
OUAT, Bhubaneswar – 751 003

3.10.08

Dr.M. Dala Behera
Professor and Head
Department of Agricultural Statistics
College of Agriculture
O.U.A.T., Bhubaneswar-751003

3.10.08

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

The written word has an unfortunate tendency to degenerate genuine gratitude into skilled formality. However, this is the only way I have to record my feelings permanently.

I deem it fortuitous and proud privilege to express my ardent sense of reverence, indebtness and gratitude to my esteemed guide, Dr. D. C. Pradhan, Associate Professor, Department of Agricultural Economics, O.U.A.T., Bhubaneswar for his benign guidance, prudent advice, keen and sustained interest, intuitive ideas, constructive criticism inspiring suggestions and persistent endeavour throughout the course of investigation. His ceaseless encouragement, patient counsel and moreover, the fatherly affection enable me to complete this study and preparation of this dissertation smoothly and successfully.

I owe my deep sense of reverence to Dr. H.N.Atibudhi, Head of the Department, Department of Agricultural Economics, O.U.A.T., for his keen interest in the subject, timely suggestions and guidance for the preparation of this thesis.

I thankfully acknowledge the help rendered by Dr.Debadutta Beura Sir and Mr. Bhagaban Mohapatra during the period of my study and investigation.

My heartfelt gratefulness and special obligation to the member of Advisory Committee, Dr.M.Dala Behera, Head of the Department, Department of Agricultural Statistics, O.U.A.T., for his ceaseless encouragement, noble advice, generous and enlightened suggestions throughout the course of investigation.

I feel elevated in expressing my profound gratitude to the venerable teachers of our department, for their valuable advice and suggestions during the course of research.

The kind co-operation of the staff members of the Department of Agricultural Economics is duly acknowledged.

I am deeply indebted to my friends especially Divya,Sweta Padma,Ramya for their timely help & co-operation in every sphere of my association with them.

I further take this unique opportunity to express my sincere gratitude to my classmates – Chinmayee, Subashree Prusty, Subashree Mohanty, Soumya, Himanshu, Deepthi Shetty, Swaroop.

My diction falls short to express my unbeautiful gratitude to my roommates, satya and Jyothi for their support and co-operation.

Trying to transform my feelings into words, I would like to express my deepest reverence to my sister who has always made an endeavour to boost my zeal and confidence with her uninterrupted blessings, heartfelt affection, sky limit care and constant inspiration.

I feel highly blissful to be the daughter of my mother whose unconditional and unfathomable love, scrupulous dedication and selfless sacrifice made me what I am today.

I feel enlightened to be bestowed by lots of love, eternal benediction and blessings of my heavenly father whose sweet unfaded memory is the inextinguishable candle of my life's inspiration.

Words are running short to express obligation and gratitude to my mother-in-law and Sister-in-law for their good wishes during the course of study.

With heartful love and affection, I express my indebtness to my husband, for his patience, sacrifice, understanding and persistent inspiration throughout the study

period, without which this thesis could not have seen the gleam of daylight. His support and encouragement made this hectic task a beautiful ending.

Lastly, I pray before the omnipotent, omniscient and ubiquitous Almighty for showing me rays of light in this world of darkness and also seeking the blessing and mercy for the future arduous journey.

Bhubaneswar
Date:

Prasanthi
(Malla Prasanthi)

CONTENTS

LIST OF TABLES

LIST OF MAPS

Chapter – I

Introduction

CHAPTER – I

INTRODUCTION

Agriculture plays a dominant role in the economy of the state like Orissa. The State has about 64.09 lakh hectares of cultivable area out of total geographical area of 155.711 lakh hectares, accounting for 41.16 per cent. Total cultivated area is about 61.50 lakh hectares. About 40.17 lakh hectares of cultivable area has acidic soil and approximately 4.00 lakh hectares suffers from salinity. About 3.00 lakh hectares of cultivable area suffers from water logging. Agriculture contributes about 26 per cent in the State Gross Domestic Product (SGDP). About 65% of the workforce depends on agriculture for their employment. The average size of holding in the State is 1.25 ha. The small and marginal farmers constitute about 83% of the farming community. The State is divided into 10 Agro-climatic zones on the basis of soil structure, humidity, elevation, topography, vegetation, rainfall and other agro-climatic factors. The average rainfall in the State is 1452 mm, of which about 80% is confined to monsoon months (June-September). The total irrigation potential created is 27.63 lakh hectares in *Kharif* and 13.31 lakh hectares in *Rabi.* The total food grain production in the State during 2007-08 is estimated to be 92.13 lakh tones, which is approx. 4.06 per cent of national food grain production. Rice is the main crop of the State.

Agriculture continues to be the mainstay of the state's economy. Nevertheless, the sector continues to be characterized by low productivity. Although the contribution of agriculture to state income has significantly declined, the percentage of work force engaged in agriculture has remained somewhat

unchanged. This implies that there has been an overcrowding in agriculture without any perceptible increase in production.

Agriculture in Orissa is characterized by low productivity on account of various factors. These factors include problematic soil (acidic, saline & waterlogged), lack of assured irrigation, low seed replacement rate, low level of fertilizer consumption (53 kg/ha. against national average of 113 kg/ha.), low level of mechanization etc. The serious gaps in yield potential and the technology transfer provide an opportunity to the State to increase production and productivity substantially.

Food grain production in the State shows a fluctuating trend due to various natural calamities. During 2001-02, there was a record production of food grains of 75.40lakh MT in 2003-04. Due to excessive rainfall with cyclonic weather in the coastal belt, the food grain production again declined to 69.65 lakh MT during 2004-05, which was less by 2.61% over 2003-04. During 2005-06, the food grain production in the State was about 73.59 lakh MT which exceeds the food grain production of 2004-05 by 5.66%. But it is still 2.41% lower than the food grain produced during 2001-02. During 2006-07, the food-grain production in the State was about 73.45 lakh MT which is almost same as the food grain production in 2005-06.

Therefore, agricultural growth holds the key to the overall development of the state by way of creating employment, generating income, providing raw materials to the industrial sector and last but not the least ensuring self-reliance in food production and food security to the deprived sections.

The State Government has developed a comprehensive Agricultural Policy and recognised agriculture as the status of an industry, considering the importance of this sector. The objective of the 11th Five Year Plan (2007-2012) is to achieve 4% sustainable annual growth in agricultural production through better management of natural resources and scientific management of crops. It also aims at doubling farmers' incomes by the end of 11th plan.

As observed from the Annual Agricultural Statistics Report of the state, the production of major crops has been showing a declining trend since last decade. In this context, an in-depth study on agricultural performance of the state is very much essential to know the extent and pace of agricultural growth in terms of area, production and productivity of major crops, direction of change in cropping pattern and factors affecting the backwardness of agricultural sector in Orissa.

Thus, the following objectives are carefully designed for the study purpose.

Objectives:

1. To study the growth pattern of major crops in Orissa over the years.
2. To examine the instability in agricultural production in Orissa.

Hypotheses:

1. Growth rate of major crops in Orissa is stagnant.
2. Instability increases along with technology.

Indian agriculture faces both opportunities and challenges with liberalisation of domestic and global markets. As regards the WTO Agreement on Agriculture, the major challenge is to remain within the system and protect the interest of the farmers. Promoting more rapid agriculture growth is important not only to achieve higher economic growth, but also to lift large number of households in rural areas out of the poverty and unemployment circle.

The chronic deficiency in the domestic production of oilseeds and pulses remains a cause of concern. This concern is widely shared in the policy exercise and emphasis has been laid on diversification of agriculture focusing on increasing the area and production of oilseeds and pulses. However, the farmers' decision to grow any crop from the alternative choices is governed by his relative advantages in the return per hectare based on productivity and prices. In the recent years, the cheaper imports under the impact of low tariff regime have been depressing the domestic prices and in turn reducing the confidence of the farmer on expected price realisation in domestic market. Therefore a comprehensive review of oil seed and pulses economy in the wake of globalisation is necessary.

The liberalisation and integration of domestic market with the international market has brought to focus the need of decision making and close monitoring of demand and supply, particularly of those traded agricultural commodities for which large number of domestic farmers are stake holders. For safeguarding the price interest of these farmers from the volatility of domestic market, the timely decisions on modulation of import by adjusting tariff become necessary. This decision making process, however, gets constrained due to the absence of realistic assessment of demand. The demand assessment for commodities like pulses and

edible oils is particularly important because of their substantial import substitution in the domestic consumption basket.

The major threshold areas in agriculture identified in the national scenario are:

1. Crop diversification.
2. Watershed management
3. Horticulture (Fruits and Vegetables)
4. Floriculture
5. Value addition and agro-processing
6. Market led extension
7. Marketing – Direct Marketing and Futures Trading

Recognising the importance of agriculture sector in the State's economy, the Government of Orissa have come up with a Comprehensive Agriculture Policy giving agriculture the status of an industry. The State Agriculture Policy 1996 aims at doubling the production of food grains and oilseeds, generation of adequate employment opportunities in the rural sector and eradication of rural poverty within a specific time frame. The main objectives set out in the State Agriculture Policy 1996 are as follows:

i) To enhance the status of Agriculture from the present level of subsistence agriculture to a profitable and commercial venture, so that young persons can accept agriculture as a means of self employment.

ii) To generate adequate employment opportunities.

iii) To adopt integrated programmes for problem soils such as water logged areas, area with soil erosion, dry / rain fed areas, area under shifting cultivation, waste land, saline and alkaline soil etc.

iv) To create entrepreneurship in the field of agriculture and horticulture.

v) To create skilled labourers for management of modern agriculture.

vi) To help mechanization of agriculture to increase productivity.

vii) To establish Agro-based industries and Food Processing Industries.

viii) To provide irrigation facilities to 50% of cultivable land through completion of incomplete irrigation projects and promotion of individual and group enterprises.

ix) To promote private enterprise in the marketing of agricultural produces.

x) To identify and promote thrust crops in different agro climatic zones of the state.

xi) To re-orient agriculture towards export.

In this study at an attempt has been made to have a comparison between the growth and development of agriculture in the State before and after the implementation of the State Agriculture Policy.

Plan of the Thesis

For the sake of analytical convenience and clarity, the thesis has been organised into six clearly defined chapters including this one. Chapter II presents critical review of theoretical and empirical studies related of this study. Chapter III presents materials and methods which includes description of study region, data base and techniques and tools of analysis of data and their limitations. Chapter IV deals with presentation of the results obtained and deals with discussion and evaluation of the results obtained with past studies. Finally, chapter V presents the summary of the main findings and policy implications of the study.

Chapter – II

Review of Literature

CHAPTER – II

REVIEW OF LITERATURE

In this chapter, a brief review of the past studies is presented.

Jayaram *et al.* (1992) reported the existence of glaring overuse of resources in production of rice in Mandya, one of the richly endowed districts of Karataka with a good infrastructural development. The high output efficiency coupled with the high inefficient use of resources, particularly in the case of small farmers is suggestive of improper pricing of resources which induces non judicious use of these resources such as fertilizer and irrigation, leading to wastage. Hence steps should be initiated to rationalize the prices of resources in production so as to improve the efficiency of their use and prevent degradation of the production capacity of agriculture.

A study conducted by Joshi *et al.* (1995) revealed that in the coastal regions, rice yield witnessed a higher growth rate as compared to rice acreage; whereas in non-traditional rice growing areas, the growth in rice acreage was higher than the growth in yield. The study further revealed that a majority of coastal districts witnessed an increase in yield variability in rice. The results of empirical findings of the study also indicated that the acreage under rice is influenced mainly by lagged acreage, rainfall received during pre-sowing months and farm harvest price. The result further revealed that the response of rice has been more consistent with the economic theory, which suggests negative relationship between risk and crop acreage. The yield response functions indicated that the areas under HYVs, irrigations, rainfall and fertilizer consumption had positive and significant effect on rice yield in a majority of cases.

Reddy *et al.* (2004) in their study on technical inefficiency in rice production and its relationship with farm specific socio-economic characteristics formed that the yield of rice considerably improved without increasing the level of inputs in the study area if the inefficiencies were reduced. They also reported that technical inefficiency in the production of rice was negatively related with farm size, education of the farmer, experience, extension contacts and percentage of good land and positively related with age and fragmentation of land. The study further revealed that the caste of the farmer and location of the farm in the canal command did not have any influence on inefficiency and also the number of farm workers in the family did not show any pattern with inefficiency. The study also indicated that to reduce inefficiency in the production of rice and wheat, measures like encouraging co-operative type of farming, land consolidation, improving literacy rate, strengthening extension services and providing alternate employment opportunities should be taken up in this area.

Saha and Swami Nathan (1994) analysed the agricultural production in West Bengal in 1980s. They employed log-linear and log-quadratic regression models for estimating the growth rates. Using an index number series on aggregate agricultural production, the exponential growth rate of West Bengal for the period of 1981-82 to 1990-91 was found to be 6.4 per cent per annum. They also found that the estimates of growth did not change substantially. When adjustments for weather were made and inferred that the growth performance could not be explained in terms of weather condition during 1980s the area and production of rice, potato, mustard and rape-seed increased steadily where as that of wheat and pulses declined. The period of high growth was not associated with greater instability in the production.

Swant and Achutan (1995) evaluated the agricultural growth performance for 1967-68 to 1992-93 on the basis of estimates of compound annual growth rates in area, crop production and yield per hectare of principal crops at the all India and State level. The Compound Annual Growth Rates (CAGR) was estimated by fitting a simple trend function to the time series of three year averages of area, production or yield per hectare. The study indicated that CAGR on non-food grains output realised during 1981-92 was 4.3 per cent exceeded significantly that of food grains namely 2.92 per cent during the same period. The area under food grains actually declined with a CAGR of –0.26 per cent during 1980s. But the food grains output continued to grow at the rate of 2.92 per cent as the growth in yield per hectare of food grains exceeded 3 per cent outspacing the negative growth rate in area to a far greater extent.

Joseph *et al.* (1996) attempted to examine the extent of commercialisation in the agricultural economy of Kerala by working out the annual compound growth rates of area, yield and production of the major crops of the state during the post green revolution phase (1970-71 to 1994-95) and two sub-periods. They also studied the evolving structure of the State's agriculture with respect to cropping pattern changes. The area under food crops declined sharply over the period, the index number for rice coming down to 58 and that of tapioca to 44 in 1994-95. Consistent increase in average was noticed for plantation crops notably rubber and coffee, their index number shooting up to 248 and 257 respectively is 1994-95.

Mallik (1996) focused his study on the variability in both production and productivity of agricultural commodities in India during 1949-50 to 1993-94. Crop wise compound growth rates showed that potato and wheat had experienced the highest and second highest growth rates in both area and production. The third

largest growth in average had taken place in the case of coconut, but its production growth rate could not keep pace with it and as a result its productivity growth rates had become negative. The study concluded that the rural productivity improvement especially through improvement in agricultural productivity had potential thrust for a considerable decline in the incidence of rural poverty.

Nadkarni (1996) studied the accelerating commercialisation of Agriculture since 1980s in India. Taking the index numbers of agricultural production, they examined that, compound growth rate per annum during the period 1949-50 to 1993-94 was 2.63 per cent for all crops, 2.49 per cent for food grains and 2.89 per cent for non-food grains. During this period, the rice production increased by 2.66 per cent while that of wheat by 5.63 per cent per annum. The production of coarse cereals increased by only 1.17 per cent per annum. The proportion of area under food grains declined during 1950-51 to 1980-81 by only 2.8 per centage points. The proportion of area under rice was almost been constant during the whole period but the proportion of area under wheat increased sharply upto 1970-71, tapered off upto 1980-81 and then stabilised between 1980-81 and 1991-92.

Vani and Vyasulu (1996) conducted a study on the growth, variability and instability of three cereal crops namely- rice, ragi and jowar in Karnataka from 1955-56 to 1989-90. They found that rice production over these 35 years showed an average annual growth of 3.9 per cent with wide fluctuation, where as the growth rate of ragi production was 6.08 per cent. The jowar production grew at 3.22 per cent and yield at 3.46 per cent per year in the state. Their study showed that the inter district variation was found to be quite high in mid 1960s and low in late 1960s and 1970s implying that adoption of green revolution took place evenly across the districts.

Bhalla and Singh (1997) in a state level analysis of recent developments in Indian agriculture presented the Indian state level data on area and output for 43 crops for a period of 1962-65 to 1992-95. There was a marked acceleration in the growth rate of agricultural output in India during the period of 1980-83 to 1992-95 as compared with earlier periods. They found that the agricultural growth had become regionally much more diversified. The major issues discussed in this analysis are : the growth rate of crop output ; changes in crop yields ; levels and growth of gross cropped area and netsown area ; input use, yield level and growth of output ; cropping pattern changes during the 1980s, changes in the agricultural labour force and labour productivity. The findings of their study revealed that there were clear regional disparities : the north-west was the main stay for food surplus provision ; there was great potential in eastern U.P., Bihar and Orissa were lagging behind. Although there was a need to give priority to R & D investment in all regions, the east, where the payoff for agricultural development would be highest needed the highest priority in planned investment. Overall there was a large scope for crop diversification and export promotion.

Rawal and Swaminathan (1998) made an attempt to examine the agricultural growth in West Bengal from 1950 to 1996. They found out the growth estimates of the rice over the years using exponential growth equation and they defended the output series and checked for stationarity using the Dickey – Fuller tables. The compound growth rate of food grain production from 1950 – 1980 was 2.56% as compared to 4.56% between 1980 to 1995. Over 75% of overall increase in rice production was attributed to increase in productivity. They observed that the difference between weather adjusted and unadjusted growth rates were small indicating that the increase in output was not only an account of good weather conditions.

Shyamal, Biswas and Bardhan (1998) gave an account of West Bengals' agricultural performance for 1977-95. For estimating the growth rates they used log-linear regression model and for analysis the trend break in output growth of jute a single point dummy variable was used. It was reported that the output growth in rice for West Bengal for the period was 4.58 per cent. The rates of growth of area, production and productivity for wheat for the state were -2.51 per cent, - 3.17 per cent and –2.38 per cent respectively for the period 1977-78 to 1993-94. The production of non-food crops at a rate of 4.71 per cent while their areas and productivity increased at more than 3 per cent. For the same period the rates of growth of area, production and productivity of pulses were –5 per cent - 3.20 per cent and –1.88 per cent.

Kurosaki (2002) reinvestigated the performance of agriculture in India and Pakistan during the period 1900-95 from historical and comparative perspectives. He applied a decomposition method known as shift share method used in studies on insectoral resource allocation effects on productivity growth. In India, total output increased at 0.5 per cent per annum before independence and growth rate was accelerated to 2.9 per cent since independence. The area efforts explained all the pre-independence growth where as land productivity effects accounted for 76 per cent of post independence growth. He concluded that the contribution of total crop shift effects is substantial explaining more than 20 per cent of post independence growth in land productivity.

Radhakrishna (2002) did a study on the promotion of agricultural growth, productive non-farm employment and high levels of social development for the growth in rural areas in India. The study revealed that in 1980s the crops like rice, oilseeds and pulses registered high growth. The growth of food production

accelerated to 2.9% during 1980s. He identified that the overall annual growth rate of agriculture declined to 3.6% during the 1990s from 3.9 per cent during the preceding decades and that of its allied sectors declined to 3.7 per cent from 4.2 per cent during the corresponding periods. He concluded that India needs an agricultural growth rate of 4.0 – 4.5 per cent to reduce poverty significantly.

Singh and Karla (2002) worked out Varietal diversity, growth and sustainability of rice production in Punjab since 1970's. During 1980s the area under crops expanded at a rate of 5.39 per cent in the state which contributed to 6.75 per cent growth rate in production. The growth rate of productivity had declined to 1.29 per cent during the 1980s and has been with a –0.34 per cent during 1990s. The total factor productivity regressed on area under rice in a quadratic form gave the highest TFP with area at about 17 lakh hectares which was considered a sustainable area in Punjab by many high-powered committees on the issue.

The findings of the study of Mahendradev (1987) revealed that during different sub-periods of 1960-61 to 1984-85, there was a progressive but marginal decline in instability in goodgrains production at the all India level. The result was in contrast to earlier studies by Mehra (1981) and Hazell (1982) which showed an increase in instability in all India food grains production after the introduction of new technology. This contrasting contrasting conclusion is due to difference in the selection of time periods. It was further observed that instability for rice, coarse cereals and pulses declined in some states and increased in some states. On the contrary, it declined in most of the states for wheat. On the relationship between growth and instability, the study found that there was no basis to believe the hypothesis of high growth causing high instability.

Saha and Swaminathan (1994) made a study on instability of aggregate production is West Bengal using linear regression function and found not that the phase of high growth in 1980s was not associated with greater instability in production level among the districts of West Bengal.

Chapter – III

Materials and Methods

CHAPTER III

MATERIALS AND METHODS

The chapter presents a description of the study region, database and analytical tools and techniques used in the present study.

3.1 Description of the Study Region

3.1.1 Geographical Location

The state of Orissa is located in the sub-tropical belt in the Eastern Region of India between 17052' and 22045' North latitude and between 81045' and 87052' East longitude. The state is bounded by the states of Bihar in the North, West Bengal in the North-East, Madhya Pradesh in the North-West, Andhra Pradesh in the South-West and by the Bay of Bengal in the East with a coast line of 480 kms. It is the tenth largest state of India, covering and area of 15.54 million hectares. The state is now having 30 administrative districts, 314 community development blocks and 51,639 villages. Since the secondary data pertaining to the area, yield and productivity for all the 30 districts are only available from 1994-95, for the spatial and temporal comparison the old 13 districts are taken for the present study.

3.1.2 Demographic Characteristics

The total population of the state according to the provisional statement of 2001 census is 368.04 lakhs which constitutes 3.6 per cent of total population of India. Of this, male and female population constitute 186.61 lakhs and 181.44 lakhs respectively. The decennial growth rate of population of Orissa between 1991 and 2001 shows a decreasing trend and it has been 15.94 per cent as against 21.34 per cent at the national level.

The density of population of the state increased from 203 per square kilometre in 1991 to 236 in 2001 as against the all-India figures of 267 and 324 respectively. There has been an increase in sex ratio from 927 females per 1,000 males in 1991 to 933 in 2001. During the period from 1991 to 2001 the percentage of urban population to total population increased marginally to 14.97 per cent in 2001 over 13.37 per cent in 1991. There has been a significant increase in literacy rate from 40.96 per cent in 1981 to 63.61 per cent in 2001 and it is below the national average of 65.4 per cent. According to 2001 census, the scheduled caste and schedule tribe population accounted for more than 38.66 per cent of the total population of the state. As per the same census, main workers constituted 26.05 per cent of the total population of the state. Of the main workers, the cultivators, agricultural labourers were 44.27 per cent and 50.80 per cent respectively. This reflects high dependency of the state economy on the agricultural sector.

3.1.3 Physiography

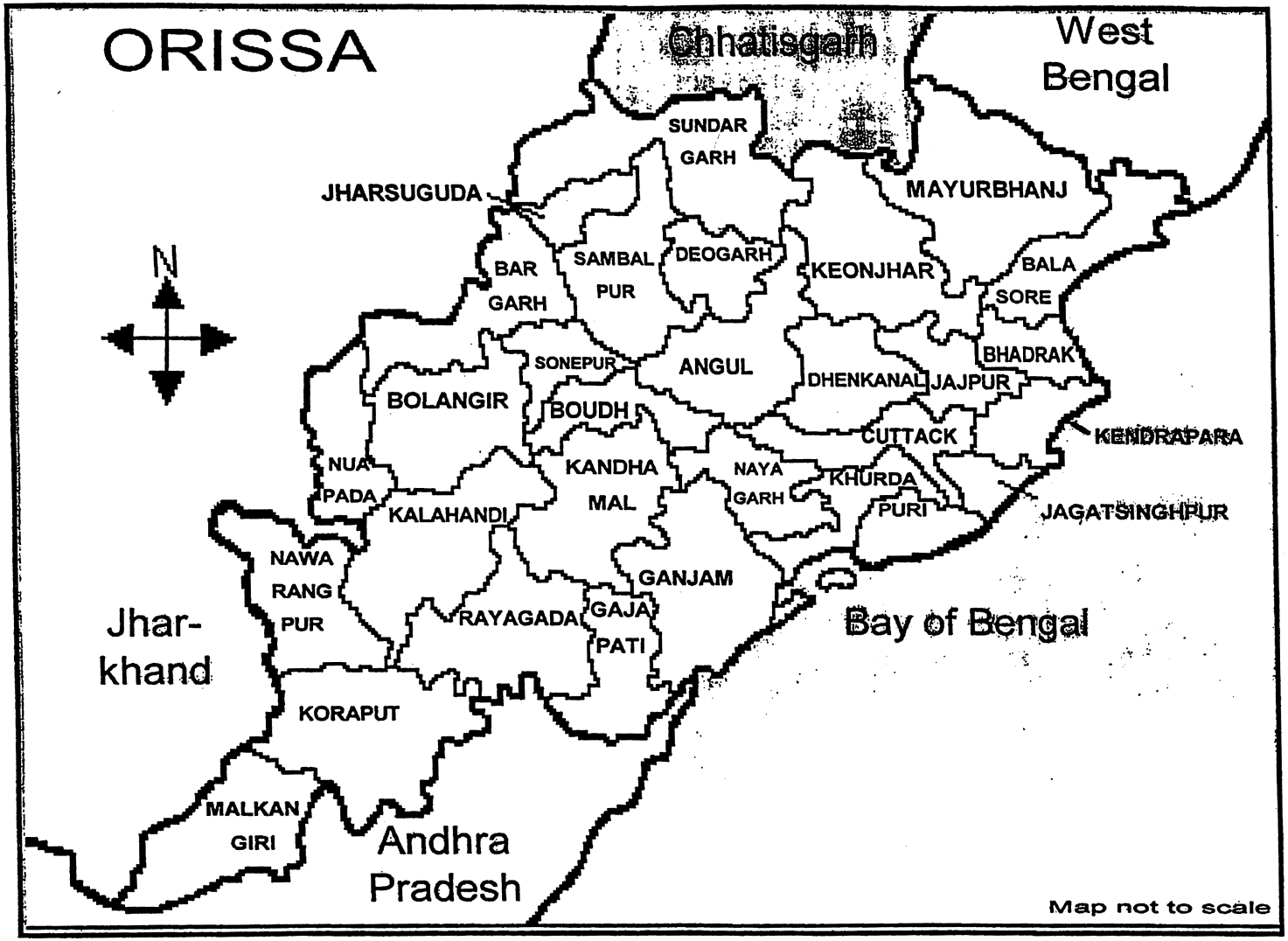
Orissa presents varied topographical features ranging from Coastal plains to high mountains and can be divided broadly into ten agro-climatic zones such as:

i) North – Western Plateau
ii) North – Central Plateau
iii) North – Eastern Coastal Plain
iv) East and South Eastern Coastal Plain
v) North - Eastern Ghat
vi) Eastern Ghat High Land
vii) South – Eastern Ghat
viii) Western Undulating Zone
ix) Western – Central Table Land
x) Mid Central Table Land

The details regarding the agricultural districts coming under the different agro-climatic zones, their normal climatic conditions and broad soil groups are listed in the following Table 3.1.

Table 3.1 Agro-Climatic Zones of Orissa

Sl. No.	Agro-climatic Zone	Agricultural Districts		NORMAL			Broad Soil Groups
			Cli-mate	Mean annual rainfall (mm)	Mean maximum summer temp (°C)	Mean minimum summer temp (°C)	
1.	North Western Plateau	Sundargarh, parts of Deogarh, Sambalpur & Jharsuguda	Hot & moist sub-humid	1600	38.0	15.0	Red, Brown forest, Red & Yellow, Mixed Red & Black
2.	North Central Plateau	Mayurbhanj, major parts of Keonjhar, (except Anandpur & Ghasipura block)	Hot & moist sub-humid	1534	36.6	11.1	Lateritic, Red & Yellow, Mixed Red & Black
3.	North Eastern Coastal Plain	Balasore, Bhadrak, parts of Jajpur & Hatadihi block of Keonjhar.	Moist sub-humid	1568	36.0	14.8	Red, Lateritic, Deltaic alluvial, Coastal alluvial & Saline
4.	East and South Eastern Coastal Plain	Kendrapara, Khurda, Jagatsinghpur, parts of Cuttack, Puri, Nayagarh & part of Ganjam	Hot & humid	1577	39.0	11.5	Saline, Lateritic, Allutial Red and Mixed Red & Black
5.	North Eastern Ghat	Phulbani, Rayagada, Gajapati,, part of Ganjam & small patches of Koraput	Hot & moist, sub-humid	1597	37.0	10.4	Brown forest, Lateritic Alluival, Red, Mixed Red & Black.
6.	Eastern Ghat High Land	Major parts of Koraput, Nawarangpur	Warm & humid	1522	34.1	7.5	Red, Mixed Red & Black, Mixed Red & Yellow
7.	South Eastern Ghat	Malkangiri & part of Koraput	Warm & humid	1710	34.1	13.2	Red, Lateritic, Black
8.	Western Undulating Zone	Kalahandi & Nuapada	Hot & moist sub-humid	1352	37.8	11.9	Red, Mixed Red & Black, Black
9.	Western Central Table Land	Bargarh, Bolangir, Boudh, Sonepur, parts of Sambalpur & Jharsuguda	Hot & moist sub-humid	1614	40.0	12.4	Red & Yellow, Red & Black, Black, Brown forest, Lateritic
10.	Mid Central Table Land	Angul, Dhenkanal, parts of Cuttack & Jajpur	Hot & moist sub-humid	1421	38.7	14.0	Alluvial, Red, Lateritic, Mixed Red & Black



Map 1 : Map of Orissa with Thirty Administrative Districts

3.1.4 Soils

The state has varieties of soils ranging from fertile alluvial deltaic soils in Coastal areas, soils with low fertility in Northern plateau, mixed red and black soils in Central table land and black soils in Eastern ghat region. The soil types differ widely from highly acidic to slightly alkaline and from light sandy to stiff clays. It has been estimated that Orissa has about 45 lakh hectares of acidic soils with varying pH value, 4 lakh hectares are exposed to saline inundation, 3.5 lakh hectares to flooding and 0.8 lakh hectare to waterlogging particularly in deltaic areas.

3.1.5 Climate

The state lies in the sub-tropical belt of medium pressure. The summer is hot and dry and is followed by wet and humid monsoon (rainy season) which lasts about four months. The autumn is pleasant. The winter is short and mild. The state, in general, has the climate characterised by high temperature and medium rainfall. Topography, however, modifies the local climate greatly. The four seasons prevailing in the state are :

(i) Hot and dry summer (March, April and May)

During this period, the maximum temperature varies from 34.8°C to 380C and mean minimum temperature varies from 23.0°C to 24.0°C. The maximum temperature of 42°C occurs in the month of May. The average duration of bright sunshine hours is 8.8 hours per day. Even though temperature remains high, the bright sunshine hours fall short of normal day length due to clouds of varying percentage.

(ii) Hot and humid wet season (June, July, August and September)

The monsoon sets in the second week of June. Rainfall intensifies during the months of July and August. For several days in July, the sky remains cloudy. The average duration of bright sunshine hour is about 3.7 hours per day. Temperature remains high (maximum 35°C and minimum 24°C).

(iii) The autumn (October and November)

During this period mean maximum temperature remains between 31°C to 32°C and mean minimum temperature varies between 17°C to 21°C. Weather remains bright. The sky remains clear and insulation uninterrupted. The average duration of bright sunshine hour increases to 7.8 per day.

(iv) Winter (December, January and February)

December is the coldest month of year. The sky remains clear and the average duration of bright sunshine hour is 6-9 per day.

3.1.6 Rainfall

The major amount of rainfall is received in the state from South-West monsoon which commences in the second week of June and continues till first week of October. The average annual rainfall of the state is 1451.2 mm. of which major amount (75 per cent) is being received during monsoon months spreading from June to September. An analysis of the rainfall data of the state reveals that there is a gradual decreasing trend in rainfall after 1960. Natural calamities like flood, drought and cyclone are most frequently observed after 1964. These have contributed to considerable instability in agricultural production in the state during post-green revolution period. The distribution of rainfall is highly erratic. In the years of normal rainfall, the distribution of rainfall controls crop yield. In the year of drought, the failure of rain causes

scarcity, while in year of excess rainfall, the amount and distribution of precipitation determine the nature and intensity of flood.

3.1.7 Irrigation

In order to attain self-sufficiency in agricultural production, expansion of irrigation has been given high priority in the state's five year plans. The state is endowed with good water resources provided by rivers, tank and from groundwater. The gross irrigation potential created in the state during triennium ending 1989-90 is 27.33 lakh hectares as against 16.24 lakh hectares during triennium ending 1979-80, registering an increase of 68.29 per cent. Of the total irrigation potential created during triennium ending 1989-90, major and medium irrigation projects account for 47.20 per cent, minor (flow) irrigation 16.32 per cent, minor (lift) irrigation 14.05 per cent and other sources (dug well, water harvesting structures) 22.43 per cent. The exploitation of groundwater resources in the state is low, being 8 per cent of total potential.

Double cropping in existing farm land is one of the basic elements of green revolution, this presupposes two crop seasons per year instead of one that depend on the monsoon. So irrigation projects were built up to support crops with adequate water supply during the growing period. Water bodies were built up to store large volumes of mosoon water which were earlier drained into rivers and sea. Irrigated agricultural land comprises less than 30% of net area sown, but produces 40% to 50% of the world's food.

3.1.8 Cropping Intensity

The cropping intensity is one of the indices of the level of agricultural development. The cropping intensity of the State went up from 151% in 2001-02 to 158% in 2006-07. Due to development of irrigation facilities, more areas

were brought under cultivation and farmers could raise more than one crop in the same land in the same year. Further, it is also revealed that the cropping intensity is highest in Puri district (208%) followed by Jajpur district (190%) and Jagatsinghpur (188%). Lowest cropping intensity has been recorded in Sundargarh district (138%). The following table shows net area sown, gross cropped area and cropping intensity from 1999-00 to 2006-07. The cropping intensity shows an increasing trend since 2003-04.

Table 3.2: Cropping Intensity for the period from 1999-00 to 2006-07(P).

Year	Net area sown	Gross cropped Area	Cropping intensity
1999-00	6075	8524	140
2000-01	5829	7818	135
2001-02	5845	8798	151
2002-03	5680	7853	138
2003-04	5796	8637	149
2004-05	5739	8718	152
2005-06	5691	8928	157
2006-07 (P)	5654	8960	158

P- Provisional Estimate

Source : Directorate of Agriculture and Food Production, Orissa.

3.1.9 Land Ustilisation Pattern

Land use classification has been presented in the following Table. It may be seen from the table that area under forest has increased marginally to the extent of 2.1 per cent over the period of seventeen years. This is a good sign, as forest land is of vital importance to maintain balance of ecosystem as well as economy. Areas under pasture and grazing land, culturable waste land, barren and fallow land need careful planning. This type of land can be used for forest area development and social forestry. The net area sown has decreased during the period from 1990-91 to 2006-07.

Table 3.3: Land Utilisation Pattern in Orissa

Sl. No.	Year	Geogra-Phical Area	Forest Area	Misc. Tree	Permanent pastures	Culturable waste	Land put to non-agrl. use	Barren & un culturable land	Current Fallow	Other fallow	Net Area Sown
1	2	3	4	5	6	7	8	9	10	11	12
1	1990-91	15571	5476	859	726	597	746	499	150	214	6304
2	1991-92	15571	5482	855	726	572	748	499	168	184	6337
3	1992-93	15571	5478	857	663	538	781	532	215	203	6304
4	1993-94	15571	5534	867	635	487	781	541	180	243	6303
5	1994-95	15571	5722	715	514	435	858	553	197	298	6279
6	1995-96	15571	5722	715	514	435	858	553	241	323	6210
7	1996-97	15571	5606	764	534	445	858	570	483	343	5968
8	1997-98	15571	5606	774	534	445	866	590	372	336	6122
9	1998-99	15571	5606	774	534	445	866	590	372	336	6048
10	1999-00	15571	5606	774	534	445	838	618	345	336	6075
11	2000-01	15571	5813	482	443	392	999	843	430	340	5829
12	2001-02	15571	5813	482	443	392	999	843	320	434	5845
13	2002-03	15571	5813	482	443	392	999	843	485	434	5680
14	2003-04	15571	5813	482	443	392	999	843	369	434	5796
15	2004-05	15571	5813	482	443	392	999	843	426	434	5739
16	2005-06	15571	5813	482	443	392	999	843	409	434	5684
17	2006-07	15571	5813	342	494	375	1298	840	526	229	5654

Source : Directorate of Agriculture and Food Production, Orissa, Bhubaneswar

3.1.10 Cropping Pattern

Agro-climatic conditions exercise big influence on the type of crop to be grown in an area. More than 75% of the cultivated area in the State is covered under paddy crop. Since the Eighth Plan, efforts are being made to divert land from paddy to cash crops like pulses, oil seeds, sugarcane, potato, etc. to ensure better returns. The following table presents the cropping pattern of principal crops in Orissa from 2000-01 to 2006-07.

Table 3.4: Cropping Pattern of principal crops in Orissa

Principal Crop	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Paddy	77.5	76.2	77.7	76.4	76.9	75.46	75.70
All cereals	81.1	79.5	80.8	79.3	79.8	78.3	78.46
Total pulses	9.7	11.4	10.9	12.2	11.2	13.64	13.42
Total foodgrains	90.8	90.9	91.7	91.5	91	91.94	91.89
Oilseeds	5.9	5.5	4.9	5.2	5.6	4.57	4.38
Fibers	1.4	1.8	1.3	1.3	1.4	1.54	1.63
Other crops (Sugar cane, Potato, tobacco, chilly and ginger)	1.9	1.8	2.1	2	2	1.95	2.10
All crops	100	100	100	100	100	100	100
Total area (1000 hectare)	5720	5907	5499	5891	5840	5932	5880.17

From the above table, it is clear that only paddy covered 75.70% of the total cropped area during 2006-07, followed by pulses (13.4%) and oil seeds (4.4%). The area under fibre crops accounted for only 1.6% and other cash crops, which include sugarcane, potato, chilli, ginger and tobacco etc. constituted only

2.1% of the total gross cropped area under principal crops. The percentage of area under pulses and food grains has increased in 2006-07 over 2000-01 while that of paddy, cereals and oil seeds have declined.

3.1.11 Selected Agriculture Development Indicators in Orissa

i) Gross Cropped Area

Total gross cropped area in the state has increased from 6761 thousand hectares in 1970-71 to 8960 thousand hectares in 2006-07. Increase in gross cropped area is found to be low in Coastal zone as compared to other zones.

ii) Fertilizer Consumption

Optimum use of fertilizer in opportune time is an appropriate strategy for increasing agricultural productivity. It also protects land fertility by meeting the nutritional requirement of crops.

Per-hectare fertilizer consumption has increased from 39 kg per hectare at the beginning of 10th Plan period to 47 kg per hectare by the end of the period 2006-07. There exists considerable interdistrict variation. About 78 per cent of fertilizer is consumed in the districts of Balasore, Cuttack, Ganjam, Puri and Sambalpur where 42 per cent of the net area is irrigated. The balance 22 per cent is consumed in the rest of the eight districts where extent of irrigation is only 16 per cent of the net area sown. The districts like Balaosre, Bhadrak, Cuttack, Jajpur, Ganjam, Kalahandi, Nawapara, Puri, Mayurbhanj, Sambalpur and Baragarh which together account for 48 per cent of gross cropped area of Orissa, have share of 66.67 per cent of the total fertilizer consumption of the state.

iii) Irrigated Area

With the frequent crop failure in the state during late sixties, emphasis has been given to increase irrigation potential of the state. The

percentage of irrigated area to gross cropped area is low in districts of Eastern Zone and Northern Zone.

The total irrigation potential created so far from all sources is about 40.54 lakh hects. (27.25 lakh hects. During *khariff* and 13.29 lakh hect. During *rabi*). The gross irrigated area during the year is about 31.56 lakh hects. (20.02 lakh hects. during *khariff* and 11.54 lakh hects. diring *rabi*). This is roughly 78% of the potential created.

iv) Area under High-Yielding Varieties

With the break-through of new crop production technology during late sixties, high-yielding varieties of seeds have been introduced in the state. The percentage of HYVs to gross cropped area as 13.13 per cent during 1980-81 which increased to 40.32 per cent during 2000-01. The areas under irrigation and HYVs are positively correlated. Over the period of one decade, there has been considerable increase in HYVs area in almost all districts of the state. The coverage under high yield varieties of different crops is 37.21 lakh hects. in 2006-07.

v) Per-Hectare Yield of Foodgrains

Per-hectare yield of foodgrains is found to be high in the districts having high, per-hectare fertilizer consumption, percentage of irrigated area and area under high-yielding varieties. Average yield of foodgrains during the triennium ending 1980-81 was 777.6 kg per ha which has increased to 937 kg per ha during the triennium ending 2000-01. The increase in productivity is due to increase in irrigation potential and application of higher fertilizer dose, extending area under high-yielding varieties, marketing and infrastructure support notwithstanding there is

widespread interdistrict variation in foodgrains. It is observed that the per hectare yield of foodgrains was higher in coastal districts than the interior tribal dominated districts.

3.2 Data Base

Data used for the study was collected from various published sources. Time-series secondary data on the area, yield and production of different crops and other agricultural statistics was obtained from various issues of "Orissa Agricultural Statistics" published by the Directorate of Agriculture and Food Production, Government of Orissa. The rainfall data was compiled from Climatological data of Orissa published by the Directorate of Economics and Statistics, Government of Orissa.

3.3 Analytical Tools and Techniques

3.3.1 Growth Model

For estimating the compound growth rates, growth model of the following type was used.

$$ln\ Y = a + b\ t + u \quad \text{.....(1)}$$

where,

Y = area / yield / production

t = time variable

u = disturbance term

a and b are the parameters to be estimated from the sample observations.

Compound growth rate (per cent annum) = (Anti *ln* b-1) × 100

Separate regressions were run for two time periods viz., period I (1993-94 to 1999-2000) and period II (2000-01 to 2006-07).

3.3.2 Quadratic Growth Rate:

Linear regression model can only capture the increasing or decreasing pattern of a quantity like area, production or yield rate. In order to capture the first decreasing and then the increasing nature of the above quantities, we use the following econometric model:

$ln\ Y = a + bt + ct^2 + u$

Where,

Y = area / yield / production

t = time variable

u = disturbance term

a, b and c are the parameters to be estimated from the sample observations.

3.3.3 Structural Changes:

By structural change we mean that the parameters of the model do not remain the same throughout the entire time period. Pertaining to agriculture, the change in production may be due to policy or technological changes.

The multi-step Chow test procedure tells us only if two (or more) regressions are different without telling us the source of the difference. The source of difference, if any, can be pinned down by pooling all the observations and running just one multiple regression as shown below:

$Y_t = \alpha_1 + \alpha_2 D + \beta_1 t + \beta_2 Dt + u$

Y - Area, Productivity or Production

t - Time period, 1.....n.

D - Dummy variable

= 0 for the period 1993-94 to 1999-2000

= 1 otherwise, i.e. for the period 2000-01 to 2006-07.

α_1, α_2, β_1 and β_2 are the parameters to be estimated from the sample observations.

3.3.4 Hazell instability Analysis

Based on the work of Goodman (1960) and Bohrnstedt and Goldberger (1969), Hazzel (1982, 1984) developed a variance decomposition technique, which decomposes the total output variability into area sown and yield components of different crops and regions. This decomposition procedure enables us to examine the sources of changes in the composition of total variability over the two time periods.

Let 'Q' denote production, 't' time period subscript, 'A' area sown and 'Y' yield per hectare. Also letting subscripts 'i' and 'j' denote crops and 'h' and 'k' denote regions , total foodgrains output of the state is :

$$Q_1 = \sum_h \sum_j A_{hj} Y_{hj}$$

The average production is:

$$E(Q_1) = \sum_h \sum_j E(A_{thj} Y_{thj})$$

$$= \sum_h \sum_j \left[\bar{A}_{thj} \bar{Y}_{thj} + Cov(A_{thj}, Y_{thj}) \right]$$

The variance of production is:

$$V(Q_1) = \sum_h \sum_j V(A_{thj} Y_{thj})$$ (Sum of individual crop variance within districts)

$$+ \sum_h \sum_{i \neq j} \sum_j Cov(A_{thi} Y_{thi} A_{thj} Y_{thj})$$ (Sum of inter crop covariances within district)

$$+\sum_{h}\sum_{h\neq k}\sum_{k} Cov\left(A_{thj}Y_{thi}A_{tkj}Y_{tkj}\right)$$ (Sum of inter-district covariances within crops)

$$+\sum_{h\neq k}\sum_{h}\sum_{i\neq j}\sum_{j} Cov\left(A_{thi}Y_{thi}A_{tkj}Y_{tkj}\right)$$ (Sum of covariances between crops in different districts)

Chapter – IV

Results and Discussions

CHAPTER – IV

RESULTS AND DISCUSSION

4.1 Analysis of compound growth rate

The co-efficients of growth rates of area, yield and production of major crops grown in Orissa namely:– pulses, total food grains and oilseeds were estimated for the thirty districts using log-linear function as discussed in the methodology chapter. The analysis was done for period (1993-94 to 2006-07). At the same time, the compound growth rates of the area, yield and production of pulses, total food grains and oilseeds of the state as whole were also estimated for the above period.

4.1.1 District-wise compound growth of major crops

4.1.1.1. Pulses

Table 4.1 shows district wise growth rate coefficients of area, yield and production of pulses in Orissa. It could be found from the table that the yield of total pulses in the state during the period (1993-94 to 2006-07) was negative and significant. It was noted that the districts viz. Balasore, Bhadrak, Jajpur, Dhenkanal, Koraput, Rayagada and Sundaragarh were having a significant negative growth trend in area. A significant negative growth trend in per hectare yield was shown by the districts viz. Bolangir, Jagatsinghpur, Jajpur, Dhenkanal, Angul, Nawapara, Koraput, Puri, Khurda, Nayagarh, Sambalpur, Bargarh, Deogarh, Jharsuguda and Sunderagarh. A significant negative growth trend in production was observed in the districts of Bhadrak, Jagatsinghpur, Jajpur, Dhenkanal, Keonjhar, Koraput, Puri, Khurda, Nayagarh, Sambalpur and Bargarh. A significant positive growth trend in area and yield were observed in Bargarh and Kalahandi respectively.

Table 4.1: Co-efficients of growth rate of area, yield and production of Pulses in ORISSA.

District	Period (1993-94 to 2006-07)		
	Area	Yield	Production
BALASORE	-.071**	-.005	-.077
BHADRAK	-.056***	.007	-.050**
BOLANGIR	.000	-.026**	-.025
SONEPUR	-.006	-.002	-.007
CUTTACK	.004	-.016	-.012
JAGATSINGHPUR	.000	-.036**	-.029**
JAJPUR	-.023**	-.047**	-.070**
KENDRAPARA	.018	-.001	.017
DHENKANAL	-.036**	-.044*	-.080**
ANGUL	-.001	-.038*	-.039
GANJAM	-.018	-.001	-.018
GAJAPATI	.023	.004	.027
KALAHANDI	-.025	.030**	.005
NAWAPARA	-.003	-.052*	-.055
KEONJHAR	.006	-.062	-.040**
KORAPUT	-.028*	-.042*	-.069**
MALKANGIRI	-.019	-.030	-.049
NAWARANGPUR	-.006	-.014	-.020
RAYAGADA	-.042***	.012	-.030
MAYURBHANJ	-.024	-.012	-.036
PHULBANI	-.019	-.010	-.030*
BOUDH	-.010	.018	.009
PURI	-.004	-.052***	-.057**
KHURDA	-.023	-.041*	-.064*
NAYAGARH	.002	-.069***	-.068***
SAMBALPUR	-.007	-.053***	-.060**
BARGARH	.017*	-.054***	-.037**
DEOGARH	.025	-.051***	-.026
JHARSUGUDA	.000	-.033***	-.032
SUNDARGARH	-.023**	-.044***	-.067
ORISSA	-.012	-.020**	-.032

* Significant at 10 per cent level
** Significant at 5 per cent level
*** Significant at 1 per cent level

Table 4.2: Co-efficients of growth rate of area, production and yield of Oil seeds in ORISSA

District	Period (1993-94 to 2006-07)		
	Area	Yield	Production
BALASORE	-.038***	.032**	-.005
BHADRAK	-.027	.030**	.003
BOLANGIR	-.044***	-.017	-.061***
SONEPUR	-.050***	-.004	-.054**
CUTTACK	-.054***	-.002	-.056*
JAGATSINGHPUR	-.072***	.036*	-.036
JAJPUR	-.007*	.018	.011
KENDRAPARA	-.077***	.042**	-.035
DHENKANAL	-.061***	.002	-.059**
ANGUL	.000	-.039**	-.038*
GANJAM	-.009	.004	-.005
GAJAPATI	-.013	-.023**	-.035***
KALAHANDI	-.048***	.037***	-.012
NAWAPARA	.011	-.035*	-.024
KEONJHAR	-.030***	-.084***	-.114***
KORAPUT	-.022	-.043**	-.065***
MALKANGIRI	.005	.028	.034
NAWARANGPUR	-.057***	-.024	-.081***
RAYAGADA	-.038***	-.024	-.062**
MAYURBHANJ	-.036**	-.014	-.050**
PHULBANI	-.079***	-.031**	-.110***
BOUDH	-.017	.053***	.035
PURI	-.035***	.026**	-.010
KHURDA	-.040**	-.003	-.043
NAYAGARH	-.032	-.053***	-.085***
SAMBALPUR	.002	-.046***	-.045
BARGARH	-.039***	-.026***	-.065***
DEOGARH	.032	-.032***	.000
JHARSUGUDA	.022	-.031***	-.009
SUNDARGARH	-.036**	-.050***	-.086***
ORISSA	-.029***	-.007	-.044

* Significant at 10 per cent level
** Significant at 5 per cent level
*** Significant at 1 per cent level

Table 4.3: Co-efficients of growth rate of area, production and yield of food grains in Orissa

District	Period (1993-94 to 2006-07)		
	Area	Yield	Production
BALASORE	-0.013***	.021	.007
BHADRAK	-.016***	.028*	.012
BOLANGIR	.002	.000	.003
SONEPUR	.004	.007	.012
CUTTACK	-.001	-.002	-.003
JAGATSINGHPUR	-.013***	.011	-.002
JAJPUR	-.017***	.004	-.013
KENDRAPARA	-.003	-.007	-.010
DHENKANAL	-.020***	.006	-.014
ANGUL	.000	-.001	-.001
GANJAM	-.010	.002	-.008
GAJAPATI	.000	.003	.003
KALAHANDI	-.001	.014	.013
NAWAPARA	-.002	-.006	-.008
KEONJHAR	-.002	.007	.005
KORAPUT	-.010**	.009	-.001
MALKANGIRI	-.005	-.001	-.005
NAWARANGPUR	.015***	.010	.025
RAYAGADA	-.020***	.004	-.006
MAYURBHANJ	-.008***	.008	.011
PHULBANI	-.013**	.005	-.007
BOUDH	.003	.021	.024
PURI	-.006	.004	-.002
KHURDA	-.011**	.001	-.010
NAYAGARH	.000	-.020	-.020
SAMBALPUR	-.001	.008	.007
BARGARH	.002	-.002	.000
DEOGARH	.010	-.023	-.013
JHARSUGUDA	.008	-.003	.006
SUNDARGARH	-.005*	-.001	-.006

* Significant at 10 per cent level
** Significant at 5 per cent level
*** Significant at 1 per cent level

4.1.1.2. Oil seeds

Table 4.2 shows district wise growth rate coefficients of area, yield and production of Oilseeds in Orissa during the period (1993-94 to 2006-07). It could be found from the table that the coefficient of growth rate for area of Oilseeds in the state showed a significant negative growth trend. It was noted that the eighteen districs of the state registered a significant declining growth trend in area. The growth trend in yield was found to be significantly negative for eleven districts of the state, whereas districts like Balasore, Bhadrak, Jagatsinghpur, Kendrapara, Kalahandi, Boudh, Puri recorded positive growth trend in yield. It was also observed that fifteen districts of Orissa recorded negative growth trend in production.

4.1.1.3. Total food grains

Table 4.3 shows district wise growth rate coefficients of area, yield and production of total food grains in Orissa during the period (1993-94 to 2006-07). It was observed that eleven districts showed a significant negative growth trend in area while Nawarangpur showed an impressive growth trend. Bhadrak showed a positive growth trend in yield while the estimated coefficients of growth rates of per hectare yield of all other districts stood unchanged

4.2 Analysis of Quadratic Growth Rate

The co-efficients of growth rates of area, yield and production of major crops grown in Orissa namely – Rice, Maize, ragi, Total cereals, Mung, Black gram, Kulthi, Arhar, Gram, pulses, total food grains, groundnut, Sesamum, Mustard, total oilseeds, Onion, total vegetable, total fibres, Spices and Condiments and Sugarcane were estimated for the period (1993-94 to 2006-07).

Table 4.4: Co-efficients of quadratic growth rate of area, production and yield of different crops in Orissa.

Crop	Period (1993-94 to 2006-07)		
	b	c	R^2
Rice			
Area	-0.0015**	0.0000	0.0590
Yield	-0.0756	0.0058	0.2120
Production	-0.0774	0.0058	0.1891
Maize			
Area	-0.030**	0.003**	0.549
Yield	-0.041	0.004*	0.378
Production	-0.070**	0.006**	0.572
Ragi			
Area	-0.048**	0.002*	0.509
Yield	-0.070	0.004	0.066
Production	-0.118*	0.006	0.208
Total Cereals			
Area	-0.118*	0.006	0.208
Yield	-0.098*	0.007**	0.161
Production	-0.106*	0.007*	0.141
Mung			
Area	-0.131***	0.008***	0.454
Yield	-0.122***	0.006***	0.710
Production	-0.252***	0.015***	0.569
Biri (Blackgram)			
Area	-0.097***	0.006***	0.498
Yield	-0.128***	0.007***	0.754
Production	-0.224***	0.013***	0.622
Arhar			
Area	-0.061**	0.003*	0.493
Yield	-0.094***	0.007***	0.594
Production	-0.155***	0.009***	0.489
Gram			
Area	-0.103*	0.007*	0.166
Yield	-0.009	0.001	0.033
Production	-0.114**	0.008**	0.209
Total Pulses			
Area	-0.132***	0.008***	0.578
Yield	-0.115***	0.006***	0.732
Production	-0.247***	0.014***	0.655
Total Food grains			
Area	-0.040***	0.002***	0.530
Yield	-0.081	0.006*	0.133
Production	-0.122**	0.008**	0.197

Crop	Period (1993-94 to 2006-07)		
	b	c	R^2
Groundnut			
Area	-0.100***	0.005***	0.784
Yield	-0.091**	0.007**	0.388
Production	-0.191***	0.011***	0.530
Sesamum			
Area	-0.161**	0.010**	0.354
Yield	-0.135***	0.007***	0.728
Production	-0.295***	0.016***	0.605
Mustard			
Area	-0.250***	0.016***	0.489
Yield	-0.135***	0.007***	0.737
Production	-0.384***	0.023***	0.630
Total Oilseeds			
Area	-0.118***	0.006**	0.635
Yield	-0.105***	0.007***	0.535
Production	-0.537	0.033	0.070
Onion			
Area	-0.090	0.002	0.522
Yield	0.217	-0.009	0.181
Production	-0.094	0.004	0.131
Vegetables			
Area	-0.193***	0.012***	0.495
Yield	0.013	0.002	0.849
Production	-0.178**	0.014***	0.478
Total fibres			
Area	0.056	-0.002	0.452
Yield	-0.043	0.002	0.061
Production	-0.163***	0.009***	0.777
Spices			
Area	-0.041	0.002	0.120
Yield	0.034***	-0.002**	0.611
Production	-0.007	0.000	0.170
Sugarcane			
Area	-0.095	0.004	0.252
Yield	0.551***	-0.022*	0.451
Production	0.456***	-0.017*	0.737
Kulthi			
Area	-0.078***	0.003	0.777
Yield	-0.165***	0.009	0.777
Production	-0.244***	0.012***	0.802

* Significant at 10 per cent level
** Significant at 5 per cent level
*** Significant at 1 per cent level

Table 4.4 shows the coefficients of Quadratic Growth rates of area, yield and production of various crops in Orissa during the period (1993-94 to 2006-07).

It was observed that the area of rice showed a decreasing growth trend during the first half of the period (1993-94 to 1999-2000), while the area of rice remained stagnant during the second half. It was observed that the yield and production of rice showed high degree of instability and stagnation.

It was observed that the area and production of maize showed a decreasing growth trend during the first half of the period (1993-94 to 1999-2000) and showed an accelerated growth during the second half of the period (2000-01 to 2006-07). Yield of maize showed an accelerated growth trend during the second half of the period, while being stagnant in the first half.

Area and production of ragi showed a decreasing growth trend during the first half of the period. Area showed an accelerated growth trend in the second half, while the production of ragi remained stagnant. It was observed that the yield of ragi showed high degree of instability and stagnation.

Area under total cereals, showed a sustained decline in growth during the first half of the period, remaining stagnant during the second half. Yield and production of total cereals also showed a sustained decline in growth during the first half, while showing an accelerated growth during the second half.

Area, Yield and Production of mung, black gram, arhar, total pulses, groundnut, sesamum and mustard showed a sustained decline in growth during the first half of the period and an accelerated growth during the second half.

Area and Production of gram showed a sustained decline in growth during the first half of the period while showing an accelerated growth during the second half. Yield of gram showed high degree of instability and stagnation.

Area and Production of total food grains showed a steady decline in growth during the first half of the period while showing an accelerated growth during the second half. Yield of total food grains was stagnant during the first half of the period, showing an accelerated growth during the second half.

Area and Yield of total oilseeds showed a steady decline in growth during the first half of the period while showing an accelerated growth during the second half. Production of total oilseeds showed high degree of instability and stagnation during the entire period.

Area and Production of vegetables showed a steady decline in growth during the first half of the period while showing an accelerated growth during the second half whereas yield of vegetables was observed to be stagnant for the entire period.

Production of total fibres showed a sustained decline in growth during the first half of the period while showing an accelerated growth during the second half.

Yield of spices, yield and production of sugarcane showed a sustained increase in growth during the first half of the period and deceleration in growth during the second half.

Area, yield and production of kulthi showed a sustained decline in growth during the first half of the period. Production of kulthi showed an accelerated growth during the second half of the period while area and yield of kulthi remained stagnant.

4.3 Analysis of Structural Changes

The co-efficients of growth rates of area, yield and production of major crops grown in Orissa namely – rice, maize, ragi, total cereals, mung, black gram, kulthi, arhar, gram, pulses, total food grains, groundnut, sesamum, mustard, total oilseeds, onion, total vegetable, total fibres, spices and condiments and sugarcane were estimated for the period (1993-94 to 2006-07).

Table 4.5: Co-efficients of Dummy variable regression model for area, production and yield of different crops in Orissa during the period (1993-94 to 2006-07).

Crop	Period (1993-94 to 2006-07)			
	α_1	α_2	β_1	β_2
Rice				
Area	8.4159***	-0.0417*	-0.0017	0.0040
Yield	7.0400***	-0.1088	0.0207	0.0016
Production	8.5488***	0.1511	0.0184	0.0062
Maize				
Area	5.133***	-0.0023	-0.265*	0.030*
Yield	7.067***	0.0061	-0.507**	0.0478*
Production	5.293***	0.0037	-0.773**	0.0784**
Ragi				
Area	5.461***	-0.0287**	-0.204	0.0282
Yield	6.817***	-0.0494	-0.182	0.047
Production	5.370***	-0.078*	-0.387	0.075
Total Cereals				
Area	8.521***	-0.002	-0.048	0.004
Yield	6.817***	-0.049	-0.182	0.047
Production	5.370***	-0.078*	-0.387	0.075
Mung				
Area	6.680***	-0.057*	-0.948**	0.119***
Yield	6.297***	-0.059***	-0.750***	0.086***
Production	6.068***	-0.116**	-1.697***	0.205***
Biri (Blackgram)				
Area	6.448***	-0.047**	-0.691***	0.092***
Yield	6.382***	-0.071***	-0.730***	0.093***
Production	5.922***	-0.119***	-1.417***	0.185***
Arhar				
Area	5.154***	-0.039**	-0.226	0.034
Yield	6.697***	-0.054***	-0.535**	0.089***
Production	4.943***	-0.093	-0.761	0.123
Gram				
Area	7.742***	-0.061**	-0.889***	0.111***
Yield	6.419***	-0.013	-0.020	0.077
Production	3.032***	-0.079	-1.200***	0.116**
Total Pulses				
Area	7.742***	-0.061**	-0.889***	0.111***
Yield	6.358***	-0.060***	-0.697***	0.087***
Production	7.193***	-0.121***	-1.589***	0.199***
Total Food grains				
Area	8.896***	-0.018**	-0.266**	0.032**
Yield	7.055***	-0.030	-0.662	0.082
Production	9.043***	-0.048	-0.929*	0.114*
Groundnut				
Area	5.851***	-0.050***	-0.615***	0.065***
Yield	7.298***	-0.036	-0.707**	0.094**
Production	6.241***	-0.086**	-1.322***	0.159***

Crop	Period (1993-94 to 2006-07)			
	α_1	α_2	β_1	β_2
Sesamum				
Area	5.988***	-0.058	-1.324***	0.140**
Yield	6.298***	-0.085***	-0.628**	0.089**
Production	5.378***	-0.143**	-1.950***	0.229***
Mustard				
Area	5.231***	-0.081***	-0.818**	0.104**
Yield	6.274***	-0.070***	-0.990***	0.103***
Production	4.596***	-0.151***	-1.725***	0.207***
Total Oilseeds				
Area	7.117***	-0.057**	-0.788***	0.086**
Yield	6.674***	-0.048**	-0.694***	0.089***
Production	6.877***	-0.104	-6.385**	0.572**
Onion				
Area	3.802***	0.001	-0.888***	0.030
Yield	7.908***	0.151	1.102	-0.143
Production	5.789***	-0.013	-0.772	0.052
Vegetables				
Area	6.894***	-0.128***	-1.267***	0.197***
Yield	9.027***	0.007	-0.074	0.029*
Production	9.014***	-0.121***	-1.322***	0.225***
Total fibres				
Area	4.188***	-0.048**	0.220	-0.037
Yield	6.582***	-0.009	-0.474	0.038
Production	6.334***	-0.087***	-1.008***	0.127***
Spices				
Area	5.082***	0.002	-0.358	0.018
Yield	7.060***	0.021**	0.192**	-0.024**
Production	5.235***	0.023	-0.166	-0.006
Sugarcane				
Area	3.836***	-0.020	-0.954**	0.073
Yield	7.886***	0.395***	3.040**	-0.379**
Production	4.814***	0.375***	2.085*	-0.307**
Kulthi				
Area	6.005***	-0.045**	-0.380*	0.037
Yield	6.377***	-0.088***	-1.056***	0.128***
Production	5.475***	-0.133***	-1.439***	0.166***

* Significant at 10 per cent level
** Significant at 5 per cent level
*** Significant at 1 per cent level

Table 4.5 shows the coefficients of Dummy variable regression model for area, yield and production of various crops in Orissa during the period (1993-94 to 2006-07).

It is observed that there is structural change in area of rice and this change is only due to change in intercept. It is observed that there is no structural change in the yield and production of rice during the entire period.

For area, yield and production of maize, it was observed that the differential intercept coefficient is statistically insignificant while the differential slope coefficient is statistically significant showing the existence of structural change during the period.

It was observed that the differential intercept coefficients for area and production of ragi are significant while the slope coefficient and the differential slope coefficients are insignificant showing the existence of structural change. It is observed that there is no structural change in the yield of ragi during the entire period.

It was observed that there is no structural change in area and yield of total cereals during the period while there is structural change in the production of total cereals.

It was observed that there is structural change in are, yield and production of mung, black gram, total pulses, groundnut, mustard, sesamum and total oil seeds.

It was observed that there is structural change in area and yield of arhar, while there is no structural change in the production of arhar.

Area and production of Gram had structural change, while yield of gram had no structural change.

In case of total food-grains, it is observed that there is structural change in the area. This structural change is due to the differences in both slope and intercept for the two periods. In case of yield of total food grains, there is no structural change, whereas in case of production, it is observed the structural change is due to change in slope.

In case of onion, it is observed that there is no structural change in area, yield and production.

It is observed that there is structural change in area and production of vegetables due to changes in both slope and intercept during the period. There is structural change in yield of vegetables due to change in slope.

It is observed that there is structural change in production of total fibres due to changes in both slope and intercept during the period. Area of total fibres showed structural change due to change in intercept only, while in the yield of total fibres there is no structural change.

It is observed that there is no structural change in area and production of spices, while yield of spices showed structural change due to changes in both slope and intercept.

In case of sugarcane, yield and production shows a structural change due to changes in both slope and intercept, while there is no structural change in the area of Sugarcane.

In case of kulthi, yield and production shows a structural change due to changes in both slope and intercept, while it is observed that the structural change in area is due to change in intercept only.

4.4 Hazell instability analysis

TABLE: 4.6 Hazell Analysis table for yield and area

Factors contributing to the change in variance: with TWO decimals	Total Cereals	Total Pulses	Total Oil seeds	Spices and condiments	Total Fibres	Total rice	Total
Change in mean Yield	0.3039	-2.8186	-0.7954	-0.0336	0.0217	0.3824	2.9602
Change in mean area	-2.9634	-0.7013	-0.2414	-0.0184	-0.4990	-0.9985	3.2617
Change in Yield variance	219.0840	-1.8574	-4.1086	-0.0048	-12.1222	215.4390	309.7808
Change in Area variance	1.6333	-73.5645	2.4087	-1.4304	0.0691	1.6981	7.8022
Change in Yield Area Covariance	-0.0034	0.0056	0.0017	0.0001	-0.0002	-0.0018	0.0179
Interaction changes in mean area and mean yield	13.5338	-29.0281	-2.3729	-0.0830	-0.5685	16.4084	84.9021
Interaction of changes in mean area and yield variances	-5.7710	0.0629	0.0612	0.0009	0.2077	-2.2263	6.4463
Interaction of changes in mean yield and area variances	0.0589	1.4080	-0.0708	0.0225	-0.0172	0.1354	0.4214
Interaction between changes in mean areas and yields and changes in area yield covariances	0.0594	0.7706	0.0527	0.0086	0.0801	0.5541	3.1812
Resdual	-210.4963	1.9091	4.1782	0.0061	12.4174	-212.2115	-318.7738
Total	15.4393	-103.8136	-0.8867	-1.5320	-0.4112	19.1792	100.0000
Factors contributing to the change in yield:							
yield	112560.4	-141274.9699	-262023.2638	4666.481296	465378.4319	223360.9167	213226.6886
area	-83474.93906	-251044.134	-132303.9889	57299.18074	30022.53667	-29595.5399	82826.73384
interaction	-1492.3875	2414.051158	1960.228165	-452.1541864	-4004.754455	-1157.075135	2207.127128
covar	6672	-6124	-416	436	505	8914	33051
total	34265.0525	-396029.273	-392782.8499	61949.13482	491901.1292	201522.221	331311.0861
Percent contribution to change in output with TWO decimals							
yield	33.97	-42.64	-79.09	1.41	140.47	67.42	64.36
area	-25.20	-75.77	-39.93	17.29	9.06	-8.93	25.00
interaction	-0.45	0.73	0.59	-0.14	-1.21	-0.35	0.67
covar	2.01	-1.85	-0.13	0.13	0.15	2.69	9.98
total	10.34	-119.53	-118.55	18.70	148.47	60.83	100.00

Note:
As sum of var. and covar. of individual items do not amount to var. and covar. of sum of values of individual items we make adjustment by replacing sum of var and covar of individual items in the total column.

From the table it is evident that in case of total cereals and total rice the variance is negative, hence the yield was less instable in the second half.

In case of total pulses, total oil seeds, spices and condiments and total fibres, the variance is positive. Hence the yield was unstable in the second half and new technologies must be intervened for the stabilization of yield.

In case of total cereals, the growth may be attributed to increase in yield while there was a negative growth in case of area and the interaction between yield and area. Which means, with increase in area, there was no conspicuous growth, though there was a total growth of 10.34% in case of total cereals.

In case of total pulses and total oil seeds, the growth is negatively attributed to yield and area.

In case of spices and condiments and total fibres, the impact of yield on the change in output though positive, is very minimal. Whereas the change in output in case of total fibres, it is highly attributed to yield. In both spices and condiments and total fibres, the change in output is positively attributed to area, but the increase in area did not keep pace with yield. i.e with increase in area, there is no increase in yield.

In case of total rice, the growth may be attributed to increase in yield while there was a negative growth in case of area and the interaction between yield and area. Which means, with increase in area, there was no conspicuous growth, though there was a total growth of 60.83% in case of total cereals.

For all the crops, the impact of yield on change in output is more than the impact of area on the change in output.

Chapter – V

Summary and Policy Implication

CHAPTER – V

SUMMARY AND POLICY IMPLICATIONS

This chapter is concerned with the summary and policy implications of the present study.

5.1 Summary

5.1.1 Backdrop of the study

Agriculture development is a *sine qua non* for economic growth of a state having an agrarian economy. Increase in purchasing power of the vast majority of population earning their livelihood directly or indirectly from agriculture would create additional demand for manufactured goods. In an underdeveloped state like Orissa, growth and development of agricultural sector not only ensures higher net farm income but also brings about equity and sustainable growth of the economy. Empirical evidence has proved that in the developing countries multiplier effect of investment in agriculture is very high resulting from high marginal propensity to consume and thus it serves as growth engine for the economy. In the context of globalisation, farmers of developing countries face a lot of challenges. The principle of comparative advantage in international trade does not hold good under WTO regime as developed countries like USA, Japan and European community are heavily subsidising agriculture under the plea of ***green box*** and ***blue box*** measures. Because of lower cost of production, the farmers of developed countries dominate world agriculture markets. In India huge influx of cheap palm oil and pulse dampened domestic price. The time is not too far when food grains from developed countries will erode the self-sufficiency in food grain production. The need of the hour is to analyse the recent growth performance of agriculture and take appropriate measures

so as to achieve the turn objective of self reliance in food grain as well as oilseed production and compete in the world agricultural markets.

5.1.2 Major Focus of the study

The present study has attempted an econometric analysis of past performance of Orissa agriculture after green revolution. The specific objectives of the present study were as follows :

1. To study the growth pattern of major crops in Orissa over the years.
2. To examine the instability in agricultural production in Orissa.
3. To establish the relation ship between growth of agricultural output and its determinants.

5.1.3 Data Base and Methodology

Time series secondary data on the area, yield and production of different crops and other agricultural statistics were obtained from various issues of "Orissa Agricultural Statistics" published by the Directorate of Agriculture and Food Production, Government of Orissa. The rainfall data were compiled from "Climatological Data of Orissa" published by the Directorate of Economics and Statistics, Government of Orissa.

Semi-logarithmic trend equations were fitted to the annual time-series data to obtain compound growth rates. To measure the instability in terms of trend in fluctuations, by examining changes over time of the deviation of actual production from estimated levels of production instability analysis was done.

Dummy variable regression model was used to examine the structural changes in the area, yield and production of different crops in Orissa from the period 1993-94 to 2006-07.

5.1.4 Main Findings

5.1.4.1 Analysis of Growth rate

The co-efficients of growth rates of area, yield and production of major crops grown in Orissa namely pulses, total food-grains and oilseeds were estimated for the thirty districts using log linear function. From the analysis, it is apparent that during the period (1993-94 to 2006-07), all the pulses, food grains and oilseeds showed a significant negative compound growth rates in case if area, yield and production. In case of pulses, traditional methods like relay cropping is being followed. Fallow land should be cultivated with arhar, mung and black gram with improved practices and high yielding varieties. New stable varieties of food grains to be introduced with balanced use of fertilizers. For oilseeds, modern technological methods and integrated crop management practices should be intervened.

The coefficients of growth rates of area, yield and production of crops in Orissa namely:- maize, ragi, total cereals, mung, black gram, kulthi, arhar, gram, pulses, total food grains, groundnut, sesamum, mustard, total oilseeds, onion, total vegetable and total fibres were obtained using quadratic growth rate. The analysis showed a decreasing growth trend during the first half of the period (1993-94 to 1999-2000) which could be attributed to vagaries of monsoon and super cyclone during the first half. Analysis also showed an accelerated growth during the second

half of the period (2000-01 to 2006-07) which could be the result of the immediate measures taken by the government toward agricultural development.

The structural change in area, yield and production of various crops in Orissa was analysed using the dummy variable regression model. The analysis reveals that there exists structural change only in area, but in case of yield and production for majority of the crops there was no structural change. Crops such as ragi, total cereals, gram, total food grains, onions and total fibres, no structural change in yield as well as in production, which indicates that there is a need for the intervention of new technologies with good, high-yielding and location specific stable varieties..

5.2. Policy Implications

5.2.1. The empirical findings of the present study reveal declining trend in the productivity of all most all major crops grown in Orissa during the last decade suggesting immediate attention in research and development to bring about a break through in agricultural technology. Dissemination of knowledge on improved package of practices should be done both through line departments and NGOs working in rural area.

5.2.2. Rules are to be designed and implemented vigorously in order to regulate the supply of seeds and seedlings of poor quality and attempts should be made for supply of good quality certified seeds.

5.2.3. Irrigation water is to be priced judiciously and economically. The extra revenue gathered from irrigation cess should be strictly invested for tapping ground water for irrigation in rainfed and drought prone areas. The on-

going irrigation projects should be completed within the stipulated period. Renovation of traditional water bodies such as tanks used for irrigation purpose during pre-independence era should be given top priority and steps should be taken for clearing of weeds in the canals.

5.2.4. Successful watershed models of neighbouring states are to be replicated in the state with people's participation and the implementing organisations should be made accountable for spending tax payer's money in order to bring a structural change.

5.2.5. Rural connectivity through all weather roads is to be speeded up so as to reach the national average of 60 per cent which will act as a growth engine for rural development within a period of five years since infrastructure is a must for growth and development in agriculture.

5.2.6. Efforts should be made for widening the coverage of National Agricultural Insurance Scheme (NAIS) in a rational manner across the state. The State Government should extent the coverage of Farm Income Insurance Scheme (FIIS) to all districts in order to integrate to the mechanism of insuring production as well as market risk.

Bibliography

BIBLIOGRAPHY

Agricultural Statistics of Orissa at a Glance (2004), Directorate of Agriculture and Food Production, Orissa, Bhubaneswar.

Alagh, Y. K. and P. S. Sharma (1980), "Growth of crop production : 1960-61 to 1978-79. Is it decelerating?," *Indian Journal of Agricultural Economics,* Vol. 35 No. 2, pp. 104 – 118.

An Economic – Cum – Purpose Classification of the Orissa Government Budget, (Different Issues from 1993 – 94 to 2003 – 2004) Directorate of Economics and Statistics, Orissa, Bhubaneswar.

Anderson, J.R. C. J. Finclay (1985), "Yield variability and modern cultivas : A single farm case study." Paper presented at the IFPRI/DSE workshop on *Sources of Increased Variability in Cereal Yields*, Feldafing, Germany, Novermber 26-29, 1985.

Balishter and S. C. Mathur (1979), "Cropping Pattern, Yields and Income under Different Sources of Irrigation," *Allahabad Farmer* Vol. 50, No. 2, pp. 201 – 208.

Barker, R., E. C. Gabler and D. Winkelmann (1981), " Long-term consequences of technological change on crop yield stability." The case for cereal grains Good security for Developing Countries, A. Valdes (Ed.), Chapter 3: 53-7A, Bouldar, Colorado : West view Press.

Bhalla, G.S. and Y. K. Alagh (1979), "Performance of Indian Agriculture : A Districtwise Study," Sterling Publishers, New Delhi.

Bhatia, H.S. (1991), "Economic constraints in increasing pulses production," *Agricultural Situation in India,* Vol. 46, No. (5) . pp. 279-281.

Chattopadhyaya, M and S. K. Maity (1991), " Structural change in composition of food grains production", *Economics and Political Weekly*, Vol. 26, No. 13 pp. A 39 – A – 43.

Dantawala, M.L. (1986), "Strategy of Agricultural Development Since Independence," *Indian Agricultural Development Since Independence: A Collection of Essays,* Oxford and IBH Publishing Co. New Delhi.

Das, P.S. (1978), "Growth and Instability in crop output in Eastern India," *Economics and Political Weekly*, Vol. 13, No. 4 pp. 1741 - 1743.

Desai, D. K. (1984)," Analysis of rice production and productivity in Eastern India." *Agricultural Situation in India*, Vol. 39, No. 5 pp. 335-341.

Dhawan, B. D. (1987), "How stable is Indian irrigated agriculture?" *Economics and Political Weekly*, Vol. 22, No. 39 pp. A 93 – A 97.

Dikshit, S. P. and A. K. Singh (1974), "Impact of Green Revolution on Agricultural Production Structure : Study of the Changes in the Cropping Pattern in Uttar Pradesh," *Agricultural Situation in India,* Vol. 29, No. 2, pp. 69 – 73.

Economic Survey 2007 – 2008, Government of Orissa.

Hazell, P.B.R. (1982), "Instability in Indian food grain production", Research Report 30, International Food Policy Research Institute, Washington, D.C., U.S.A.

Hazell, P.B.R. (1984), "Sources of increased instability in Indian and U.S. cereal production," *American journal Agricultural Economics.* Vol. 66, No. 3, pp. 302 – 311.

Joseph, K. J. and M. V. Srinivasagowda (1996), "Commercialisation of Kerala's Agriculture : Its Extent and Implications", *Indian Journal of Agricultural Economics,* Vol. 51, No.4, pp. 692.

Joshi, P.K. and T. Haque (1980), "Long-term prospects of agricultural growth viewed the light of soil-climatic, technological and institutional constraints, and costs involved in their removal," *Indian Journal of Agricultural Economics,* Vol. 35, No. 4, pp. 1 – 9.

Kaushik, Krishan Kant. (1993), "Growth and instability of oilseeds production." *Indian Journal of Agricultural Economics,* Vol. 48, No. 3, pp. 334 – 338.

Mahendradev, S. (1985), "Direction of change in performance of all crops is Indian agriculture in late 1970s.: A look at the level of districts and agro-climatic regions", *Economics and Political Weekly,* Vol. 20 No. 51, pp. A 130 – A 136.

Mahendradev, S. (1987), "Growth and Instability in Food grains Production : An Inter-state Analysis", *Economic and Political Weekly,* Vol. 22, No. 39, pp. A 82- A 92.

Mallik, G. (1996), "Variability in Production and Productivity of Agricultural Commodities in India during 1950-51 to 1993-94 : Some Policy Implications", *Indian Journal of Agricultural Economics,* Vol. 51, No.4, pp. 711-712.

Mishra, B. (1983), " Deceleration of rates of agricultural growth in Orissa: trends and explanatory factors", *Indian Journal of Agricultural Economics.* Vol. 28, No. 4, pp. 591 – 604.

Mukherji, S and M. Sanyal (1997), "Growth and Institutional Change in West Bengal Agriculture, 1901 – 1988" Occasional Paper, No. 161, Centre for Studies in Social Sciences, Calcutta.

Nadkarni, M. V. and K. H. Vedini (1996), "Accelerating Commercialisation of Agriculture – Dynamic Agriculture and Stagnating Peasants," *Economic and Political Weekly,* June 29, pp. A – 63 – A – 72.

Narayana, N. S. S. and A. Ganesh Kumar (1993), "On Analysing Growth and Stability of Agricultural Performance : A case study of cereal crop yields in India and Andhra Pradesh," ISI, EAU, Technical Report.

Ninan, R. N. (1987), "Edible oilseeds – growth and area responses," *Economics and Political Weekly,* Vol;. 22, No. – 39, pp. A 97-110.

Oberoi, R.C.; T.V. Moorti and R. K. Sharma (1988), "Optimisation of Cropping Pattern on Tribal Farms", *Agricultural Situation in India,* Vol. 42, No. II, pp. 959 – 963.

Orissa Agricultural Statistics, (Different Issues from 1993 – 94 to 2006 – 2007), Directorate of Agriculture and Food Production, Orissa, Bhubaneswar.

Pal, S. and A. S. Sirohi (1988), "Sources of growth and instability in the production of commercial crops in India," *Indian Journal of Agricultural Economics,* Vol. 43, No. 3, pp. 456 – 463.

Pal, S. and A. S. Sirohi (1989), "Instability in Indian crop production: Its magnitude and sources," *Artha Vijnana,* Vol. 31 No. 3, pp. 241 - 256.

Panda, S, and S. C. Patnaik, (1984), "Trends and Problems of Oilseeds Production in Orissa," *Agricultural Situation In India,* Vol. 38, No. II, pp. 717 – 725.

Patil, R. G. and D. Jha (1978), "Output growth and technological change in Maharashtra agriculture : A district wise analysis," *Indian Journal of Agricultural Economics,* Vol. 33, No. 3, pp. 31 – 39.

Patro, G. K. and B. C. Sahu (1983)," Performance of Rice – Based Cropping Patterns in the Irrigated Uplands of Orissa," *International Rice Research Newsletter,* Vol. 8, No. – 6, pp. 30 – 31.

Radhakrishna, R. (2002), "Agricultural growth, Employment and poverty – A policy perspective," *Economic and Political Weekly,* January 19, pp. 243 – 256.

Rajapurohit, A. R. (1983), "Recent Trends in Agricultural Growth Rates in Karnataka," *Indian Journal of Agricultural Economics,* Vol. XXXVIII, No. 4, October – December, pp. 585 – 590.

Ranade, C. G. (1980), "Impact of cropping pattern on agricultural production," *Indian Journal of Agricultural Economics,* Vol. 35, No. 2, pp. 85 – 93.

Ranga Rao, I.V. and A. K. ray (1985), "Stagnation in Production of pulses: A quantitative analysis," *Agricultural Situation in India,* Vol. 40m No. 5, pp. 369 – 376.

Rangarajan, C. (1982), "Agricultural growth ad industrial performance in India," Research Report 33, *International Food Policy Research Institute,* Washington, D.C., U.S.A.

Rao, C. H. (1997), "Agricultural Growth, Sustainability and Poverty Alleviation in India ; Recent Trends and Major Issues of Reform", Lecture Presented on

December 10, 1997, at International Food Policy Research Institute, Washington, D.C.

Rao, V. M. (1996), "Agricultural Development with a Human Face – Experiences and Prospects," *Economic and Political Weekly,* June 29, 1996, pp. A-50, - A- 60.

Rath, N. (1980), " A note on agricultural production in India during 1955 – 78" *Indian Journal of Agricultural Economics,* Vol. 35, No. 2, pp. 94 – 103.

Rath, N. (1989), "Agricultural Growth and Investment in India," *Journal of Indian School of Political Economy,* Vo. 1, No. 1, January – June.

Ray, S. K. (1983), " An empirical investigation of the nature and causes for growth and instability in Indian agriculture: 1950 – 80", *Indian Journal of Agricultural Economics,* Vol. 38, No. 4, pp. 459 – 474.

Reddy, B.; M.A. Krishna, M. J. Jayakumar and B. K. Kumaraswamy (1992), "Stagnation of Food Production in Karnatak State: 1980s", *Drought Monitoring Cell,* Bangalore.

Reddy, G. P. and K. C. Hiremath, (1984), "Instability in cereal production and new technology in Karnataka state – A district level analysis," *Agriculture Economic Research Bulletin,* 13, University of Agricultural Sciences, Karnataka.

Reddy, V. N. (1978), *"Growth rates", Economics and Political Weekly,* Vol. 13, No. 19, pp. 806 – 811.

Reserve Bank of India, (1984), "Agricultural productivity in Eastern India", *Report of the Committee on Agricultural Productivity in Eastern India,* Bombay.

Sadasivan, S. (1989), "Pattern of pulses production – An analysis of growth trends", *Economic and Political Weekly,* A167 – A179.

Saha, A and M. Swaminathan (1994), "Agricultural Growth in West Bengal in 1980s : A Distintegration by Districts and Crops" Economics and Political Weekly, Vol. 29, No. 13, pp. A – 2, A – 11.

Sawant, S. D. (1983), "Investigation of the hypothesis of deceleration in Indian agriculture," *Indian Journal of Agricultural Economics,* Vol. 38, No. 4, pp. 475 – 496.

Saxena, H. K. (1987), "Vertical growth rate in agricultural sector in India: An analytical approach," *Agricultural Situation in India,* Vol. 42, No. 8, pp. 715- 719.

Swaminathan, M. (1995), "Outstanding Performance: Agricultural Growth in West Bengal," *Frontline,* March 24.

Thakur, H. C. and N. N. Sharma (1988), "Production Potential and Economic Profitability of Different Cropping Patterns Including Cereals, pulses and oilseeds", *Indians Journal of Agricultural Sciences,* Vol. 58, No. 3, pp. 194 – 201.

Tripathy, S. and B. Bhuyan (1989), "Growth of crop output in Orissa," *Orissa Economic Journal,* Vol. 14, No. 1- 2, pp. 28 –35.

Tripathy, S. and S. Gowda, M.V. Srinivasa (1993), "An analysis of growth, instability and area response of groundnut in Orissa", *Indian Journal of Agricultural Economics,* Vol.48, No. 3, pp. 345 – 350.

Venkateswarlu, B., A.V. Rao and A.S.R. Prasad (1985), "Impact of different factors governing rice production in India – An appraisal from 1955 to 1982", *Agricultural Situation in India,* Vol. 40, No. 6, pp. 515 – 519.

Vikas, R, and M. Swaminathan (1998), "Changing Trajectories : Agricultural growth in West Bengal, 1950 to 1996," Economic and Political Weekly, October 3, pp. 2595 – 2602.

Walker, T. S. (1984), "HYVs and instability in sorghum and pearl millet production in India," *Economic Program Progress Report* 63, ICRISAT, Hyderabad, Andhra Pradesh, India.