

**INTER-STATE DISPARITIES IN AGRICULTURAL
DEVELOPMENT IN INDIA – STATUS AND POLICY
IMPLICATIONS**

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NEW DELHI 110 012**

2002

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DEVELOPMENT IN INDIA – STATUS AND POLICY
IMPLICATIONS**

By

MOHAMMAD MIZANUL HAQUE KAZAL

A Thesis

Submitted to the Faculty of the Post-Graduate School, Indian
Agricultural Research Institute, New Delhi, in partial fulfillment of
the requirement for the degree of

**DOCTOR OF PHILOSOPHY
IN
AGRICULTURAL ECONOMICS**

2002

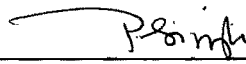
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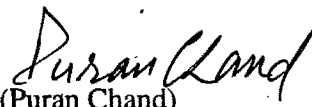
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CERTIFICATE

This is to certify that the thesis entitled “**Inter-State Disparities in Agricultural Development in India – Status and Policy Implications**” submitted to the faculty of Post-Graduate School, Indian Agricultural Research Institute, New Delhi, in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY** in **AGRICULTURAL ECONOMICS** by **Mr. Mohammad Mizanul Haque Kazal** embodies the bonafide research work carried out by him under my guidance and supervision. No part of the study reported here has so far been submitted anywhere for publication or for any other degree or diploma.

It is further certified that such help or sources of information as have been availed during the course of this investigation have been duly acknowledged by him.

New Delhi
March 18,2002


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ACKNOWLEDGEMENTS

I am extremely grateful and indebted to Dr. Puran Chand, Principal Scientist, Division of Agricultural Economics, Indian Agricultural Research Institute (IARI), New Delhi and Chairman of my Advisory Committee for his invaluable guidance, his continued moral support, his constant encouragement, his humane approach, and for his being a great source of inspiration throughout the course of study and preparation of this manuscript.

I feel immense pleasure in expressing my heartfelt sense of gratitude to Dr. Parmatma Singh, Dean & Joint Director (Education), IARI, New Delhi and co-chairman of my Advisory Committee who has provided professional and moral support during the entire course of this study.

I am greatly indebted to Dr. Anil Rai and Dr. R.C.Goyal, Division of Agricultural Statistics and Computer Application respectively, Indian Agricultural Statistics Research Institute, New Delhi and Members of my Advisory Committee for their kind help and guidance, whenever needed. I duly appreciate their constructive criticisms and encouragement throughout this study.

My sincere thanks are due to Dr. R.P.Singh, Head, Division of Agricultural Economics, IARI, New Delhi for providing the necessary facilities in the division to complete the study.

Thanks are also due to Dr. P. Kumar, Professor, Division of Agricultural Economics, IARI, New Delhi for source of inspiration for hard work and unflinching support to complete the study successfully.

My heartfelt thanks are to Dr. B.R.Atteri, Principal Scientist and Dr. Pramod Kumar, Scientist, Division of Agricultural Economics, for patiently going through the

manuscript and offering valuable comments. My special thanks are due to Dr. V.C. Mathur, Dr. A.K. Vashisht, Principal Scientists, Dr. Amit Kar, Senior Scientist and Dr. P.S. Badal, Dr. Alka Singh, Dr. Ranjit Kumar and Dr. Shiv Kumar, Scientists, Division of Agricultural Economics for their cooperation and kind help during the course of study.

I am ever grateful to Dr. Mahabub Hossain, Head and Program Leader, Social Sciences, IRRI, Philippines who has shown keen interest in my research work and strengthen his genuine capacity to help me.

I extent my hearty regards to Dr. M. Khalilullah and his family, World Health Organization (WHO), New Delhi for taking special care to me and my family during the study period at IARI, New Delhi.

I am grateful to Mr. Jitendra Kumar, Joint Director, Central Statistical Organisation, New Delhi for his ready help during the data collection for this study.

I offer special thanks to Indian Council of Cultural Relations (ICCR), Government of India, for providing the scholarship for pursuing my Ph.D. degree. I am also thankful to Vice-Chancellor of Shah Jalal University of Science and Technology, Sylhet, Bangladesh for granting the study leave.

I acknowledge the help and cooperation received from all the Staffs from Division of Agricultural Economics, IARI, New Delhi. My sincere thanks are due to Dr. Mahendra Singh, Technical Officer and Mrs. Sushila Ahlwalia for their kind cooperation at all stages during my study period.

The present study based on secondary data that have been collected from different Libraries of New Delhi. Since, in addition to the Libraries of the Indian Agricultural Research Institute, Indian Agricultural Statistical Research Institute and the Library of Division of Agricultural Economics, I have used the services of

the Libraries of the Directorate of Economics and Statistics, the Central Statistical Organization, National Institute of Public Finance and Policy, Indian Institute of Public Administration, New Delhi. I am grateful to these organizations for allowing me to make use of their facilities and to the staff of these Libraries for assisting me in searching the needed data and information.

I take this opportunity to express my deep sense of affection and thanks to all my colleagues and friends whose presence turned my stay at IARI a pleasant one to be cherished in my life long memories.

My gratitude goes to my late father and my mother-in-law who greatly inspired me in my current higher studies. Their goodwill and support will always be a good memory for me. Words are not sufficient to express my gratitude to my beloved mother, whose affection and blessings throughout the course of this study were of great encouragement to me. Lastly, but not the least, let me appreciate the "lady behind success" my wife **Begum Nasrin Jahan** and my son **Muhammad Nayeem Mubasshirul Haque** who have borne, the brunt of arduous task silently. Without their wholehearted support, understanding, constant prayers and cheering up, I could not have completed this mission in time. I am deeply indebted to my relatives and family members for their affection, love and constant inspiration.

Finally, I am thankful to the Director, IARI, New Delhi for granting me permission to join the Post-Graduate School and take up this study and to the officials of the Post-Graduate School, IARI for their excellent cooperation and help.



New Delhi
March 18,2002

(Mohammad Mizanul Haque Kazal)

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ACRONYMS AND ABBREVIATIONS

AgNSDP	Agriculture Net State Domestic Product
AP	Andhra Pradesh
AS	Assam
BH	Bihar
BLUE	Best Linear Unbiased Estimator
CADI	Composite Agricultural Development Index
GDP	Gross Domestic Product
GJ	Gujarat
HP	Himachal Pradesh
HY	Haryana
HYV	High Yielding Variety
ICAR	Indian Council of Agricultural Research
IN	All India
IRRI	International Rice Research Institute
JK	Jammu and Kashmir
KN	Karnataka
KR	Kerala
MH	Maharashtra
MP	Madhya Pradesh
OLS	Ordinary Least Square
OR	Orissa
PB	Punjab
PCA	Principal Component Analysis
PCR	Principal Component Regression
RJ	Rajasthan
TN	Tamil Nadu
UP	Uttar Pradesh
WB	West Bengal

CHAPTER I

INTRODUCTION

India is a country with a vast geographical area with widely divergent characteristics from one region to another. A vast country of sub-continental size with marked regional disparities in agro-climatic, environmental, resource endowment and population density and is characterized by uneven economic and agricultural development among various regions (Bhalla and Singh, 1997; Kumar, 2001). It is also well established by the several recent studies that the disparities existed in different aspects of economic development across the states (Mahendradev, 1987; Sarker, 1994; Kurian, 2000; Ahluwalia, 2000, Dasgupta et al., 2000). Nevertheless, agriculture has all along been the most crucial sector of the Indian economy. Agriculture and allied activities make the largest contribution in the Gross Domestic Product (GDP), though the share of agriculture sector has come down from 59 per cent in 1950-51 to 27 per cent in 1999-2000. It provides employment to around 65 per cent of the total work force.

Agriculture is not only foremost contributing sector of income and employment but is also one of the major sources of foreign exchange earning in India. The share of agricultural products in total export earnings was around 21 percent of total exports in 1999-2000. Besides, agricultural growth has direct impact on poverty eradication in country. Agricultural growth is also an important factor in raising agricultural wages, containing inflation and for employment generation. It still plays a dominant role in determining the national income (Ninth Five Year Plan, 2000). Moreover, agricultural

development plays an important role in the economic development of the country (Khanna and Pavate, 1992; Ram, 1989).

Agricultural development is a multidimensional concept consisting of technological advancement, effective management of the available resources and organizational set-up (Naregal and Togarsi, 1992; Ram, 1989). This notion of agricultural development has a variety of implications. Agricultural development is adaptation of agriculture to new conditions and fuller development of its latent potentialities. The problem of agricultural development is not merely that of bringing in new technology of increased production but also that of changing the structural base (Sadhu and Mahajan, 1985). Therefore, the economists, sociologists, political thinkers, planners and administrators have the different view of vision for the success of economic development programs, which ultimately depends on the agricultural development.

Indian agriculture in mid sixties witnessed radical transformation through technological and biological innovations, for food security and self-sufficiency. This fundamental change and application of agricultural innovations revolutionized the traditional farming and brought about remarkable success in food grains production in India. In this process, the role of agricultural technology is recognized as an important source of growth in agriculture. The new agricultural technology has generated more income and employment to the cultivators. However, the technological and biological breakthrough in Indian agriculture has got a significant response in the some regions, while others are still lying in the embryonic stage of development.

Agricultural development has a great impact to alleviate the poverty in an agrarian economy. Poverty in rural India has declined substantially in recent decades. The steady decline in poverty is strongly associated with agricultural growth, particularly the Green Revolution. The past studies have found an inverse relationship between growth in agricultural income and the incidence of rural poverty (Saith, 1981; Ahluwalia, 1985; Srinivasan, 1985; Gaiha, 1989; Ghose, 1989; Ghosh, 1993, 1996, 1998; Bell and Rich 1994; Fan, et al. 1999; Narayanamoorthy, 2001). Ultimately, this success has been achieved by launching the various programs for agricultural development throughout the country. Since, the agricultural development programs influence on directly or indirectly to reduce the rural poverty. However, poverty reduction in rural India has also shown considerable regional variation due to unbalanced agricultural development across the states. Hence, it is essential to promote the balanced agricultural development to reduce the rural poverty.

The country has achieved the self-sufficiency in food production, though poverty and hunger still exist due to uneven development of the states. Besides, the growth and adoption of new agricultural technology is not identical all over India. Due to uneven and rapid adoption of technology some states achieved higher productivity through exploitation of their resources and use of modern inputs. In productivity acceleration, fertilizer consumption, mechanization, energy consumption and area under high yielding varieties (HYVs) have contributed more to this differential pattern of growth and with the result that some states or regions have developed much faster while others have remained backward (Sharma and Mahajan, 1996; Singh and Chand, 1989). Since, several

factors have contributed to this differential pattern of agricultural development. However, this is the proper time to take initiative for faster development of agriculture in the under-developed states through identifying the problems, constraints and causal factors. Since, the national policy of the Indian government has aimed at reducing inter-regional disparity (Chelliah, 1996).

Needless to mention that the introduction of modern production technologies have brought about substantial increase in agricultural productivity and overall production. But the gains of such increase are said to have been shared unevenly by the factors of production and productivity of the regions (Jha, 1974; Shah, 1976; Vidyasagar and Ahuja, 1977; Shafi, 1984; Jairath and Sarup, 1991). Moreover, it is usually observed that the imbalanced regional agricultural development is impeded by regional disparity in resources mobilization. These regional disparities are burgeoning day by day. The agricultural development plans in the past have been unable to achieve balanced development and reduced the regional disparities.

The issue of widening inter-state disparities is growing concern for balanced development across the states as a development strategy. Since agriculture is the largest sector of the Indian economy, its balanced development is crucial for reducing inter-state disparities. But, the balanced agricultural development is retarded due to wide regional disparity in agricultural resources, lack of infrastructural support, capital inadequacy and growth potential in the region. Further, the uneven propagation of new agricultural technology has augmented the increased regional disparities. It is often argued that the inter-state disparities in agricultural, infrastructural and socio-economic factors have

been propounded differences in agricultural development. Keeping in view these facts, a detailed investigation into the level of disparities in agricultural development across the states is aim of this study. This study also attempts to identify the potential factors and contribution of the factors to agricultural development in various states and all India. Thus, the study is a comprehensive approach to find out spatial and temporal disparities in agricultural development across the states. Very few studies in the past have addressed these concerns. Keeping these facts in view, it becomes imperative to undertake the study, which could examine the extent of inter-state disparities and to identify causative factors for disparities across the states.

Objectives:

The specific objectives of the study are given below:

1. To examine the temporal and spatial disparities in agricultural development across the states;
2. To identify the potential factors of agricultural development in various states;
3. To assess the contribution of the potential factors of agricultural development across the states;
4. To suggest policy measures to minimize the inter-state disparities and promote balanced agricultural development in the country.

Hypotheses:

The following hypotheses have been drawn in this study:

- The process of agricultural development is a multi-dimensional concept, which includes agricultural, infrastructural and socio-economic factors, these are inter-dependent and inter-related with each other.

- The potential factors of agricultural development are evenly distributed across the states that promote the balanced development all over the states.
- All the potential factors are positively associated with the agricultural development and significantly contributed to the development of agriculture in the state.

Organization of the study

This study is organized into five parts, namely introduction, review of related literature, conceptual and methodological framework, results and discussions, and summary and conclusion. The introduction has given some inception about the study and rationales of the research problem with the specific objectives. A rigorous review of literature that related directly or indirectly with the study is presented in Chapter II. The third chapter describes the analytical framework of the study and the data employed for analysis in this study and their sources. A discussion of the results of the study is presented in Chapter IV. A summary of the study and the results along with the conclusions is presented in Chapter V.

CHAPTER II

REVIEW OF LITERATURE

The present study deals with the inter-state disparities of agricultural development and analyses various causes responsible for temporal and spatial disparities in agricultural development. As such, there is remarkable variation in the agricultural development and in the use of agricultural resources across the states. In the state level analysis of agricultural development one finds some states are well developed, while the others are less developed. Since, regional distribution of resources is an important aspect for balanced development across the states. In this chapter, therefore, a brief account of the studies undertaken by the other researchers, which are directly or indirectly related to the objectives and analytical techniques of this study. Keeping in view, the imbalances of agricultural development, infrastructural and socio-economic factors across the states, the studies have been reviewed under the following sub-heads for lucidity and convenience:

2.1 Regional disparity in agricultural development

2.2 Emerging factors of regional disparities for agricultural development

2.3 Application of Principal Component analytical tool

2.1 Regional Disparity in Agricultural Development

Regional disparities in development arise because of various factors, such as resources – both natural and human, insufficient investment, lack of local initiative. Not only there are differences in physical conditions, such as climate, man-land ratio, soil, irrigation and communication, but also wide opportunities exist to bridge-up the imbalances among the regions. Hence, this

section reviewed the multiple type of studies those are concerned with inter or intra regional disparities and factors causing imbalances. In addition, related studies on agricultural development have been reviewed and presented in this section.

Singh (1981) addressed to the Indian Society of Agricultural Economics and discussed imbalances in agricultural growth in India with particular reference to the states of Punjab and Orissa. The study analyzed the growth of agricultural production at the all India and states level, and regional disparities in agricultural growth compared to population growth. A comparative study was made of the rates of growth of production, area and productivity, foodgrains, wheat, rice, and milk production in Punjab and Orissa and at the all India level during the period 1959-60 to 1978-79. The factors contributing to differential growth in the two states were identified. The possibilities for increasing agricultural production were discussed and suggestions were given for reducing regional imbalances in agricultural development.

Dabrowskii and Bolin (1982) examined the causes and effects of regional differences and discussed appropriate policies from the point of view of an agrarian geographer. The natural conditions and socio-economic historic developments, which led to declining rural regions, out-migration of young workers, poor demographic structure and decay of infrastructure and services, were outlined. Social, economic and technical reasons were given to show that in such cases, support from outside was not sufficient though it may help meet certain aims. The real priorities can only be established from development programs initiated within the disadvantaged rural areas themselves, which

reveal the most urgent needs. Generally, it has to be recognized that short-term planning and pursuit of economic efficiency was likely to widen regional disparities and that many more case studies of less favored rural regions and of the impact on them of agricultural policies are necessary to devise satisfactory solutions.

Subbarao(1985) appraised the issues relating to regional equity in a large country like India. A sketch of colonial history and initial conditions was followed by a discussion of recent trends in the regional pattern of agricultural output and surpluses. It then examined the regional distribution of gains from the states' major incentive policies for the agricultural sector. The impact of these policies on the poorer eastern states was then discussed. Finally, the changing class character and role of the state in the context of the growing regional differences in Indian agriculture was discussed. Since, the introduction of new seed varieties in the mid sixties there has been a sharp accentuation of regional disparities in Indian agriculture. A substantial proportion of increased production originated in five or six advanced states, and the poorer eastern states and the semi-arid zone participated little in this impressive national performance. This growth in the advanced states was aided by state-induced market price distortions resulting in heavy subsidies and the easy availability of subsidized public funds. The consequence of this policy failure to halt regional disparities has been massive poverty, malnutrition and shrinkage of effective demand for wage goods in the poorer states, together with the accumulation of food stocks with the government and a rise in regional tension.

Narain *et al.* (1991) dealt with the quantification of development efforts effected in various socio-economic fields by constructing composite index of development based on information of fourteen important indicators in seventeen major states of the country. This study was undertaken over two period of time i.e. 1971-72 and 1981-82 with the objective of examining the significance of change and variability in development. Attempts have also been made to estimate potential targets for the underdeveloped states to bring equity in development. The states of Haryana and Punjab observed to be better off in socio-economic development where as states of Assam, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh had remained at the low ebb of development during both the periods. The overall level of development was found to be significantly different between the two time periods. The study concluded that the various developmental programs have resulted in an improvement during the second period, its impact appears to have been eroded by the rapid growth of population in most of the states. Special care should be taken to allocate resources optimally on per capita basis for improving the socio-economic conditions of under developed states.

Narain *et al.* (1994a) evaluated the socio-economic status of various districts of Andhra Pradesh with the help of composite index of development based on thirty socio-economic variables combined in an optimum manner. The study utilized data for the year 1991-92 on the thirty indicators out of which eleven indicators were directly concerned with the agricultural development and rest of the nineteen indicators depicted the progress of social and human resource development. It was found that the variability in agricultural

development was of higher order as compared to variability in over all socio-economic development. The study revealed that the regional disparities with regard to overall socio-economic development was observed to be greatly influenced by agricultural development in most of the districts of the state. The infrastructural facilities also influenced the socio-economic development in the positive direction in almost all the districts of the state.

Narain *et al.* (1994b) estimated the level of socio-economic development of different districts of Kerala with the help of composite index of development based on forty-two socio-economic variables combined in an optimum manner. The study utilized data for the year 1991-92 on forty two socio-economic indicators out of which seventeen indicators were directly concerned with agricultural development, five indicators depicted the progress of development in the industrial sector and the rest twenty indicators presented the level of development in infrastructural service sector. The level of development was examined separately for agricultural, industrial and infrastructural service sectors. The variation in the level of development in industrial sector was observed to be of higher order as compared to the variation in agricultural and infrastructural service sectors. Positive significant association was found between the levels of development in agricultural and industrial sectors indicating that the growth and progress of agriculture and industry had been going hand in hand in the state. For bringing about uniform regional development in the state, model districts for the poorly developed districts had been identified and the potential targets for various indicators had been estimated. The study revealed that the low developed districts required

improvements of various dimensions in almost all the indicators for enhancing their level of overall socio-economic development.

Narain *et al.* (1996) studied the level of development of various districts of Maharashtra with help of composite index based on optimum combination of forty-three economic indicators. The district-wise data for the year 1991-92 on forty-three economic indicators were used. The level of development was examined separately for agricultural, industrial, infrastructural and overall socio-economic developments. Wide disparities have been observed in the level of development in different districts. The socio-economic development was positively associated with the growth and progress of development in agricultural and industrial sectors in the state. The infrastructural facilities have a greater impact in enhancing the level of socio-economic development but these facilities were not fully utilized in the growth and development of agriculture. The study revealed that the low developed districts required improvements of various dimensions in most of the indicators for enhancing their level of development on the basis of identification of model districts for the poorly developed districts.

Jaishankar and Raman (1997) examined whether convergence of regions is taking place in India or whether there is regional disparity, based on pioneering studies on the convergence hypothesis and on regional disparities. Sensitivity analysis was carried out using the Barro and Sala-i-Martin equation and different measures of inequality were used to test the robustness of the convergence tests and to ascertain the extent of disparity. The results indicate

that the claim of regional convergence does not hold true. Inter-state disparities have increased during the period 1960-90.

Bhatia (1999) attempted to build a composite index of rural infrastructure state-wise by taking into consideration 14 major sub-items of infrastructure for the year 1994-95 and examined the relationship between infrastructure development and levels of production and growth in agriculture. It has been found that overall index of infrastructure was the highest in Punjab followed by Kerala, Tamil Nadu and Haryana. The infrastructure index was the lowest in Rajasthan and only slightly higher than this in the states of Bihar and Madhya Pradesh. The overall infrastructure was also relatively low in the states of Orissa, Uttar Pradesh, West Bengal and Assam and it was moderately good in the states of Gujarat, Himachal Pradesh, Jammu and Kashmir, Karnataka and Maharashtra. The study has established strong relationship between rural infrastructural development and level of per hectare yield of foodgrains as also value of output from agriculture. It revealed that there is significant scope for increasing the yield of foodgrains and agricultural income by improving the rural infrastructure of those states, which are having poor infrastructure. Since, the development of infrastructure in these states would require large-scale investment in these sectors that in the long-term perspective would be enormous in terms of higher rate of economic growth.

Narain *et al.* (1999) conducted a study to obtain the level of development of different districts of the states of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu belonging to the southern region of the country with the help of composite index based on an optimum combination of thirty economic

indicators. The data on the economic indicators for the year 1991-92 have been used in the study. Among the most ten advanced developed districts of the southern region, seven districts came from the state of Kerala, two districts belong to Andhra Pradesh and one district came from Tamil Nadu. Similarly among the ten most backward districts of the region, six districts came from Andhra Pradesh, two districts belong to Karnataka and remaining two districts from Kerala. Hence, wide disparities have been observed in the level of development among different districts of the region. In order to reduce the disparities and improve the levels of development, potential targets for various developmental indicators have been estimated for low developed districts.

Shukla *et al.* (1999) analyzed the trends in economic development for 17 states of India and constructed composite indices of economic development using secondary source data. The study identified the backward, highly backward, developed and highly developed states with respect to agricultural, infrastructure and overall development. Punjab and Haryana found to be highly developed and Orissa and Rajasthan least developed. It concluded that a policy for infrastructure with a rural bias is needed for the economic development of these two agriculturally backward states.

Dasgupta *et al.* (2000) studied growth of interstate disparities in India. This study was subjective in nature. It found that establishing the divergence or convergence relationship among the Indian States in itself is an interesting and challenging exercise as well as worth reporting. It also revealed that a clear tendency for the Indian States to have diverged during the period in question as far as per capita State Domestic Product (SDP) is concerned. In terms of the

shares of different sectors in the SDP, however, there seems to be a tendency for overall convergence towards the national average.

Narain *et al.* (2000) studied the level of development of different districts of Tamil Nadu with the help of composite index based on an optimum combination of forty-two socio-economic indicators. The district wise data on most of the indicators were for the year 1994-95. A wide disparity in the level of development among different districts is observed. The socio-economic development was positively associated with the growth and progress of agricultural development and infrastructural facilities. It concluded that the low developed districts require improvements of various dimensions in different indicators for enhancing the levels of development and reduce the disparities in the level of development.

Kurian (2000) in his study was restricted to a comparative analysis of the emerging trends in 15 major states in respect of a few key parameters, which have an intrinsic bearing on social and economic development. The analysis clearly established that there are considerable disparities in socio-economic development across the Indian states. The study showed that during early 1980s with increased participation by the private sector appears to have aggravated regional disparities. The ongoing economic reforms since 1991 with stabilization and deregulation policies as their prime instruments and a very significant role for the private sector seem to have further aggravated the interstate disparities.

2.2 Emerging Factors of Regional Disparities for Agricultural Development

Development constitutes a multitude of factors such as natural resources, human resources, capital, technology, public policies, and institutions and organizations. These factors are basic pillars of development and eventually help to promote the agricultural development of a country. In this regard, so many factors have contributed in the development of agriculture in India, though, these are unevenly distributed and large variation exists across the states. In view of these variations, the studies related with regional disparities for agricultural development have been reviewed. Moreover, the review will help to give a proper shape to the present study and distinguish it from other studies.

Alavi (1973) reported that the impact of the Green Revolution on different population groups and regions has been quite uneven for all Western Pakistan farmers and rural population although the overall rate of growth of agricultural production has outstripped population growth. The relative importance of various factors such as tube-well irrigation, in augmenting crop output has been analyzed and the skewed distribution of resources in the agrarian economy was emphasized. A secondary effect of the Green Revolution was that for farmers whose physical farm output did not go up, absolute real incomes deteriorated as a result of the inflationary pressures and increased demand for manufactured consumer goods. The system of agricultural taxation and subsidies had served to accentuate the disparities among different strata of farmers and different regions.

Mohan (1974) made an attempt to estimate the contribution of expenditure on research and extension activities to changes in real productivity in Indian agriculture over the period 1952-53 to 1970-71. Particular attention was paid to the intensive agriculture districts program as an example of the package approach to extension. The total factor productivity index was specifically designed to measure output changes net of the contribution of conventionally measured inputs. The major conclusions emerged from the study were as follows: the total factor productivity gains in agriculture in some parts of India have been truly extraordinary. The regional disparities have become greater over the period under review and these may well have been partly caused by governmental allocation decisions. The gains realized have not been associated exclusively with the Green Revolution in space or in time, or with the extent of irrigated acreage. The major determinant of productivity change in Indian agriculture has been the Indian agricultural research system and the investment in the research system has yielded social rates of return far in excess of those realized in other developmental activities. The extension programs were successful where significant economic slack exists; they did not discover new technology but can merely make production more efficient.

Singh and Sirohi (1974) examined the impact of the Green Revolution on the growth rates of production of rice, wheat, bajra and maize and consequent regional disparities in different Indian states. The study found that the agricultural strategy based on new technology and its selective area approach through the extension of area under the high-yielding varieties of seeds created disparities in the states. By the growth rates of productivity

showed the varying impact of the Green Revolution and it also affected the per caput food grain, cereal and wheat production. Thus the equity objective also was adversely affected.

Mathur (1977) briefly discussed regarding backwardness and development efforts in his study. The characteristics of backwardness were then examined in order to explain the results obtained in past development programs in India and to suggest effective solutions to the problems. Factors responsible for regional disparities were summarized. It was concluded that the beneficiaries were almost always the dominant group of the population. Development of an infrastructure of roads and power, irrigation, agriculture, livestock husbandry, industry, credit and marketing institutions must take place simultaneously if any impact is to be made on the overall development of an area. The combination of these different programs cannot be centrally determined but must take into account local resources and local needs. Therefore, comprehensive coordinated regional or area planning is very important.

Reddy (1978) assessed irrigation needs, potential and problems in the drought-prone Anantapur district of Andhra Pradesh, examining some fairly small-scale irrigation projects. It was observed that the regional disparities in income were often due to geo-climatic differences between areas in India in a predominantly agricultural economy. Arid or semi-arid conditions prevail over one-third of the country, making agriculture highly vulnerable to drought. These disparities have been further accentuated by recent advances in agricultural technology, which were more suited to irrigated areas. It is essential to provide

create more irrigation infrastructure in order to make agriculture reasonably productive.

Tewari and Sharma (1979) studied the performance of commercial banks' agricultural credit policy from 1969 to 1977. The quantitative performance of commercial banks in agricultural financing was assessed with reference to the flow of agricultural credit, pattern of agricultural advances, branch expansion program, credit-deposit ratio in the rural sector and participation of banks in schemes or programs for rural development. The qualitative performance was judged by examining the flow of credit to small and marginal farmers and reduction in inter-regional disparities in the flow of agricultural credit. The study revealed that the quantitative performance of commercial banks in agricultural financing during the period was impressive but their qualitative performance was not up to expectation. These banks could not achieve a substantial break-through in bringing the small and marginal farmers within their operations.

Bal (1980) studied regional imbalances in farm family incomes in Punjab. The empirical evidence showed that the benefit of increased farm incomes has not been evenly shared between different regions of Punjab. New technology has not benefited everyone; this was due to regional differences in resource endowments and cropping patterns. The high farm income was attributable to soil-climate-crop combination and especially the assurance of irrigation in Region I. Off-farm income was also higher. It was concluded that with the growth of farm income in Region I investments in off-farm activities also increased resulting in higher levels of off-farm income. The technological

break through has contributed to the widening of regional disparities in farm and off-farm incomes in Punjab.

Joshi and Haque (1980) estimated the relative role of technological, institutional and climatic factors in the determination of temporal and regional variations in agricultural growth in India. The long-term prospects of balanced agricultural growth in India were examined. State wise data of agricultural output and inputs for the years 1955-56 to 1975-76 have been analyzed. Compound growth rates were worked out for both input and output for the pre and post Green Revolution periods. There was not only large-scale inter-regional disparity and temporal fluctuations in the existing agricultural growth rates, but there was also a likelihood of such disparity affecting future growth. In states such as Assam, Himachal Pradesh, Kerala, Orissa and Uttar Pradesh the growth rates of agricultural output in the Green Revolution period were much lower than in the pre-Green Revolution period. In Punjab, Haryana, Bihar and Andhra Pradesh where the growth rates were high during the Green Revolution period, though in the 1970s it was much lower than the previous decade. Regional disparities and temporal fluctuations in growth were explained by differences in both qualitative and quantitative variations in fertilizer consumption, area under irrigation, high-yielding varieties, rainfall and credit.

Tripathy (1980) studied whether intra-state regional disparities have followed an international model of widening disparities, the national model of constant disparities, or whether the disparities have decreased to change in the regional disparities in the possession of private capital in Orissa state. Changes were presented in the relative positions of 13 districts in the state during 1960-

61 and 1972-73, using the simple method of ranks, economic distance and changes in distances between regions. The districts were classified into high resource potential, low resource and growing resource potential according to their ranking. The results of the study indicated that unlike the international or the inter-state pattern, the inter-district economic disparities showed a substantial decrease over time. Among the various factors that influenced the level of production, major irrigation was the only significant one that explained inter-district differences in the level of production. A heavy public investment in the relatively backward region was making the region grow over time, even in regard to private capital. A differential growth in public investment in such circumstances with a higher growth in the backward regions can become a principal factor in reducing regional disparities.

Grewal and Sharma (1982) studied inter-regional disparities in farm costs and returns and examined the factors responsible for these disparities in Punjab. It was observed that there were significant variations in gross value of output, costs and net returns between different regions. They recommended that it is essential to minimize such disparities in order to meet the national objective of growth with social justice and to add to the agricultural production of the state.

Saini (1982) examined the social choice between alternative agricultural development strategies based on two of the most important inputs in agriculture such as irrigation and fertilizer. The object of the analysis was to throw up evidence, which may provide guidelines for an appropriate input-based strategy for agricultural development and a policy for public investment in irrigation and

fertilizers. Results showed that there was a strong case for public investment in extending irrigation to hitherto unirrigated areas rather than concentrating on intensifying the use of modern inputs in areas, which already have assured irrigation facilities. The social objective of reducing inter-regional disparities in agricultural development lends further support to this strategy. It was also observed that it is socially desirable to apply limited supplies of chemical fertilizers over a larger area at less than the optimum dose rather than use the same amount intensively in a smaller area.

Bhagat (1983) examined the extent of inter-regional disparities in the agricultural infrastructure and direct and indirect role of infrastructure in determining the level of agricultural productivity in Bihar with the help of cross-sectional data across the districts. The composite index of infrastructure and adoption were constructed and regional differences along with agricultural productivity were measured. The study revealed the existence of inter-regional differences in the level of infrastructural facilities. It was observed that infrastructure is a significant determinant of the level of agricultural productivity.

Shrivastava (1983) reported that agriculture occupies an important place in the economic life of Madhya Pradesh and the state has accorded a very high priority to agricultural production programs, including minor irrigation and land development, in successive Five Year Plans. However, the overall state position concealed considerable regional and district differences due to prevalence of different farming practices, techniques and attitudes of farmers. The areas having assured rainfall and facilities for controlled irrigation have recorded

steady progress, while the areas with low rainfall and poor irrigation have shown slow and unsteady progress. It was recommended that an appropriate strategy should be devised for developing the agriculturally backward districts.

Bajpai (1984) examined the extent of inter-regional disparities in agricultural infrastructure in Allahabad district and the direct and indirect role of infrastructure in determining the level of agricultural productivity using cross-sectional data across tehsil in Eastern Uttar Pradesh. While agricultural productivity in the region was generally low, it was considerably higher in Allahabad, probably due to adequate infrastructure in some parts of the district. In other regions, where these facilities were poor, agricultural productivity was lower. Since, the results showed the existence of inter-regional differences in the level of infrastructural facilities. Inter-regional differences in the use of new agricultural practices and level of agricultural productivity were also found. The study concluded that infrastructure contributes a lot to modern agriculture and therefore, a suitable policy for infrastructure with a rural bias is needed for agriculturally backward regions.

Singh (1984) made an attempt to determine district profiles of levels and rates of agricultural development aimed to help in evolving area specific strategies of agricultural development for backward areas of Uttar Pradesh. Wide regional and districts level differential in the levels of agricultural development in the state was observed. A group of districts in the western region enjoys a relatively higher level of prosperity. All districts have experienced a clear and marked improvement in the level of agricultural output and productivity, although there have been wide differences in the growth rates.

Moreover, agricultural development was spatially more widespread during the post-Green Revolution period. During this period there was also a marked acceleration in rates of growth, accompanied by a lesser degree of inter-district differentials. The growth rates of agricultural output and productivity have been generally higher in the western districts and remarkable growth was also recorded in Hill, Bundelkhand and Central regions. Regional disparities in levels of agricultural development have shown an increasing trend during the planning period. The study concluded that agricultural development policy in the state should strive to ensure a spatially widespread pattern of growth, focusing specially on the low productivity and low growth districts, which are often co-terminus.

Dev (1985) attempted to examine whether HYV technology has widened changes in regional disparities for all crops in terms of output per area and output per caput and the interconnections between the two measures were examined across agro-climatic regions in the late 1970s and compared with the early 1970s and 1960s. The general conclusion for agro-climatic regions was that such regions were becoming relatively richer which were superior in terms of output per caput as well as output per area. Though poor areas have not become poorer, they have remained relatively poor in terms of output per area. The poor regions have become poorer in terms of output per caput.

Kakkar (1985) studied the impact on regional imbalances of various programs of rural development implemented by the Government of Uttar Pradesh during the Sixth Five Year Plan (1980-85). It concluded that the rural development programs have contributed towards the development of the rural

areas and that this in turn is reflected in the overall regional development and in the reduction of regional disparities.

Ray and Sharma (1985) examined inter-regional disparities based on average fertilizer consumption data by district for the periods 1962-65, 1970-73 and 1978-81. The results of the study confirmed that inter and intra-regional disparities have widened as a result of the adoption of modern technologies. There is a need for a shift in policy in favor of equity-oriented growth as the only way of distributing the benefits of modern technology more evenly.

Tewari (1985) studied the regional disparities in agricultural development in the state of Uttar Pradesh. The disparities were attributed to variations in the natural endowment of the regions and the technical level of farming practices. The state was divided into 5 regions and the land-use patterns, distribution of holdings, agricultural labor, production and productivity, consumption of electricity and fertilizers, use of agricultural machinery and implements, and irrigation were compared. It is concluded that regional imbalances in agricultural development are evident which needs to be corrected through regional planning.

Dadibhavi (1986) examined the inter-regional disparities in agricultural facilities across the Karnataka state on the basis of cross-sectional data for the periods 1960-61, 1970-71 and 1980-81. Also, the study evaluated the role of infrastructure in determining the level of agricultural productivity in the state. The study revealed the prevalence of inter-regional disparities in agricultural infrastructure facilities in Karnataka. It depicted marked inter-district variations in the output per farm worker and per hectare. It is revealed that the coastal and

eastern regions of Karnataka were sufficiently endowed with infrastructure but the northern drought prone region was poor in infrastructure. A similar pattern was identified in the use of new agricultural practices and the levels of productivity for all three periods. It was observed that the availability of infrastructure induced the farmers to go in for extensive use of new agricultural practices. Agricultural infrastructure is therefore, an important determinant of the level of agricultural productivity in Karnataka. The study concluded that infrastructure contributes a great deal to modern agriculture and therefore, a suitable policy for infrastructure with a rural bias is needed for the development of agriculturally lagging regions of the state.

Hossain (1986) examined the role of irrigation in agricultural development in Bangladesh by quantifying the relationship of fertilizer consumption and adoption of high yielding varieties with irrigation, and estimating the effect of irrigation on the intensity of land use and the growth of crop output and productivity, using 1983-84 district level cross-section data. The results showed a stronger relationship between irrigation and the growth of crop output and productivity and further confirmed the conclusion that irrigation poses the key technological constraint to agricultural development in Bangladesh.

Mishra *et al.* (1987) investigated the inter-regional differences in the level of infrastructural facilities in Eastern and Bundelkhand regions of Uttar Pradesh. It was found that Bundelkhand region was relatively better endowed with infrastructural facilities as compared to Eastern region where three-fourths of the districts were poor in these facilities. But the Eastern region was

relatively more advanced in terms of adoption of new agricultural practices and in agricultural productivity as compared to Bundelkhand region. Indirect association of infrastructure with agricultural productivity through the use of new agricultural practices was also of high order in eastern region and of low order in Bundelkhand. The study concluded that investment on infrastructure for adoption of improved agricultural practices would reduce the regional imbalances.

Rizvi and Rizvi (1987) pointed that the introduction of new agricultural technology (NAT) to India in 1965-66 led to a substantial increase in agricultural production. The paper examined its effect on income distribution, employment, asset concentration and regional equality considering the major components of NAT (HYVs, chemical fertilizers, etc.). It is concluded that the NAT favored large farmers, widening the income gap between large and small farmers and between farm owners and landless labourers. There was increased concentration of assets in the hands of the larger, wealthier landowners. The NAT strategy was concentrated on the high productivity areas, thus increasing regional disparities.

Dadibhavi (1988) analyzed the regional disparities in the flow of institutional credit into India's agricultural sector, the influence of commercial banks in regions where cooperatives are already well established and the distribution of credit among borrowers of different size holdings. The study showed that regional disparities in total institutional credit outstanding have widened over the years. Assam, Bihar, Haryana, Jammu and Kashmir, Punjab,

Rajasthan, Uttar Pradesh and West Bengal were identified as credit deficit states.

Dev (1988) made an attempt to analyze inter-state variations in agricultural labor productivity growth in India. It also examined the incidence of rural poverty and the interrelations between labor productivity and rural poverty over four selected time points. The analysis revealed that yield was the major source of growth in labor productivity, and it is concluded that the poverty-reducing impact of labor productivity has increased during the period since the introduction of new technology.

Haque and Verma (1988) studied the relative importance of institutional and non-institutional credit in India's agricultural sector, highlighting regional variations and the distribution of institutional credit among various income groups of farmers. The study was related to the period 1971-72 to 1981-82. It is revealed that institutional credit tends to favor the relatively progressive regions and well-off farmers. Small and poor farmers have to rely mainly on private sources of credit.

Singh (1988) examined the natural resource endowments, input use, agricultural production and productivity of each region of Uttar Pradesh. A wide difference among regions was observed and an agricultural development strategy was proposed for each region and for the state as a whole.

Bhalla and Tyagi (1989) investigated the spatial pattern of the levels and growth in agricultural output in the country, as also the variations in labor productivity at the state level. In the case of foodgrains, the analysis was based on the comparison between the quinquennial ending 1973-74, 1978-79 and

1983-84. For the 19 major crops, the analysis was based on the comparison of three triennia ending 1964-65, 1972-73 and 1982-83. While taking the entire period 1962-65 to 1980-83, it was observed that every major state in India recorded some increment in its aggregate value of output of the 19 major crops. But, taking the two sub-periods, they observed that during the first period the value of output declined perceptibly in Maharashtra and to some extent in Orissa and Andhara Pradesh whereas, during 1970-73 to 1980-83, Maharashtra and Andhara Pradesh recorded substantial positive addition to their value of output, the only states where there was some decline in output were Tamil Nadu and Kerala.

Krishan (1989) was concerned with the factors explaining the persistent poverty in India, how various parts of India differ in terms of their relative development level and the underlying processes accounting for such a pattern and whether regional disparities have increased or decreased over time. The study was based partly on a survey of the relevant research material already published and partly on an analysis of data pertaining to selected indicators of development. The study concluded that the appropriate strategies for not only accelerating the overall development process but also narrowing the disparities at the regional level.

Mruthyunjaya and Kumar (1989) discussed how the crop production strategy followed in the post-Green Revolution period in India has led to the narrowing of the base of agricultural production. Changes were examined in input use, productivity, and cost of production, profitability and employment in the production of major crops for 1972-83. Cropping pattern changes over the

period 1972-86 were analyzed. Area under rice and wheat has increased continuously in many states at the cost of coarse cereals, millets, pulses and in some areas, cotton. A variety of factors make rice and wheat production more profitable than other crops. They found that the costs of this development were serious imbalances in the cropping pattern, widened regional disparities, increased instability in production and unplanned imports.

Singh and Chand (1989) examined inter-state differences in the rate of improved technology adoption and agricultural growth using the 3-yearly average of the periods 1970-73 and 1980-83. In particular, the study discussed changes in technological factors such as area under HYVs, fertilizer use, and electricity consumption for irrigation and agricultural purposes, availability of tractors and electric and oil pumpsets, gross cropped area under irrigation, cropping intensity and yields. Large inter-state disparities in the level of adoption of technology and infra-structural facilities, as well as in the use of agricultural machinery, were observed. In states such as Punjab, Haryana and Uttar Pradesh, where changes to modern technology have taken place, agricultural production has increased greatly. In Orissa, Madhya Pradesh, Rajasthan and West Bengal, little change in technology has resulted in the low growth of agricultural output. In order to even out such differences, special extension and research efforts should be directed towards popularizing new technology in these states. They concluded that the institutional credit should be provided for long term credit needs while essential inputs should be made available at subsidized rates.

Gangwar and Pandey (1990) made an examination of the inter-state disparities in agricultural development in India and also of the salient features of agro-climatic regional planning for balanced agricultural growth and development. A very high degree of variation has been observed among states in cropping intensity, irrigated area, percentage of total cropped area under food grains, per capita state domestic product and share of agricultural sector in total state domestic product. They suggested that in order to achieve the objective of growth with social justice, these inter-regional as well as intra-regional disparities are needed to be minimized through appropriate policy measures. An agro-climatic regional planning approach was adopted to formulate agricultural development plans by delineating the country into broad 15 agro-climatic zones, which were further divided into 73 sub-zones. By this study, agro-climatic parameters for the district/state were derived by superimposing administrative boundary maps into the agro-climatic zonal maps. At the micro-level, optimal plans for various categories of farmers are needed to be derived by using suitable optimization models.

Goel and Haque (1990) made an attempt to map the country into several regions, using numerical taxonomy techniques and cluster analysis. The similarities observed in the pattern of remoter states, which defy geographical zones and the shifts in their relationship with change in parameters were the important observations provided by this analysis. The study concluded that the utility of an analysis employing numerical taxonomy and cluster analysis techniques was the focusing of inherent inter-state variations with respect to different sets of parameters for farm production defying geographical regions.

Jairath (1990) examined the extent of regional disparity in the flow of rural credit from the primary agricultural cooperative credit societies (PACS) in Himachal Pradesh. For analytical purposes, the state was divided on the basis of the level of rural development into 3 categories namely: the developed, the developing and the backward regions. A composite index of rural development was formulated on a number of criteria and regional disparities in cooperative credit service were compared for June 1977 and June 1987. The findings suggested that there was a growing imbalance in the population served per society, cropped area served and rural deposits per PACS. However, the cooperative societies have played an important role in reducing regional imbalance in credit deployment.

Sharma (1990) found that the uneven rates of agricultural growth observed between the states are probably largely determined by inheritance laws but reinforced by differential infrastructural development. The compound growth rates of food grain production in various states for the period 1966-67 to 1987-88 showed that Punjab ranked first, followed by Haryana, Uttar Pradesh and Maharashtra. On the other hand, the states of Tamil Nadu, Gujarat, Kerala and Rajasthan experienced insignificant improvement in output, with Kerala actually showing negative growth rates. Possible determinants were analyzed under the headings of cropping intensity, average size of land holdings, the intensity of tractorization, fertilizer use and the area under high-yielding variety cultivation. It is concluded that inter-state disparities could be considerably reduced if extension education and training facilities are provided, with an efficient network of necessary inputs, by the government. A liberal credit policy

would have to accompany such measures if the objectives of raising income and employment prospects are to be met.

Krishnaji and Sekhar (1991) attempted to identify the nature of relationship, if any, between agrarian development and population growth. Data were collected at the district and state levels and pertaining to population, cropped area, irrigated area, value of production and so on. They looked at the inter-state inequalities in per-capita production, productivity per hectare and land-man ratio and analyzed a Malthusian and Boserupian type adjustment process in response to population change. It was concluded that widening inequalities in income was a result of intensified use of farm inputs in well-endowed regions and the negligence of others. These disparities were somewhat mitigated by the public distribution system. The decline in the land-man ratio was not considered a threat to small landowners and may be the consequence of limited migration possibilities.

Malik *et al.* (1991) provided evidence on the role of institutional credit on agricultural output, and the determinants of access to institutional credit using household level data from the 1985 Rural Credit Survey of Pakistan. Ordinary least squares estimates presented the determinants of total output, thus highlighting the relative importance of institutional credit on agricultural output. Maximum likelihood estimates of a probit model for determining access to institutional credit were also presented. The study provided statistically significant evidence of the importance of the role of institutional credit in the determination of agricultural output. Education, farm size, electrification, mechanization and mean level of village credit have a significant positive effect

on access to credit, but dependency, tenurial status and attitude may pose constraints.

Singh and Gupta (1991) examined the state-wise growth rates of fertilizer usage and looked at the inter-regional disparities in consumption in an effort to identify the determinants of fertilizer consumption. Data for the study were based on secondary sources for the periods 1967-68 to 1977-78, and 1978-79 to 1988-89. Compound growth rates were calculated and coefficients of variation estimated taking into account variables like irrigation, credit, area under cultivation and area under HYV seeds. Evidence pointed to considerable disparities between states, which were aggravated by the inception of the new technology but were somewhat reduced when the techniques got more widely diffused. The key determinants of fertilizer consumption were identified as the provision of irrigation and the availability of credit from primary agricultural credit societies. Hence it is recommended that the government implement state-specific policies to reduce disparities in fertilizer consumption.

Singh and Grover (1991) analyzed the shift in crop patterns over time in different regions of the Punjab, and inter-regional disparities in the agricultural value productivity and the contribution of various crop systems to this. The state productivity index was plotted for the period 1960-61-1988-89. The shifts in cropping pattern, value productivity and cropping intensity of various zones of the state in 4 sub-periods were compared. There has been a significant shift in the cropping patterns in the state since 1960-61. The area under rice and wheat showed a fast increase in the traditional paddy area in the initial period, but later slowed down, while the central districts of the state registered a rapid increase

in the area under wheat and rice until 1984-85. The results of the value output per hectare and per holding showed that the cotton belt which lagged behind in value output per hectare in the pre-Green Revolution period, observed a higher increase in the latter period.

Thakur (1991) studied agricultural imbalances at different levels to find suitable strategies for balanced regional agricultural development. It was more concerned with the identification and analysis of regional disparities in the agricultural productivity pattern in the South Bihar plain. The environmental, technological and social factors affecting productivity levels were dealt with. This provided an appropriate conceptual base for understanding regional disparities in agricultural productivity and to suggest methods for increasing productivity.

Gahukar (1992) reported that the Green Revolution helped the country to feed the people, to stop importing food grains and to increase the employment potential. But increasing human population and slow industrial growth resulted in economic imbalance. The Green Revolution was confined to certain crops (rice, wheat) at the expense of others. The high input technology created problems of continuous monoculture cropping, depletion of the water table, deterioration of soils, introduction and multiplication of insect pests, plant diseases and weeds, intensive use of energy, chemical fertilizers and pesticides, increase in soil salinity and alkalinity, environmental pollution and ecological imbalance. Socioeconomic inequalities have been enlarged in rural areas and the land/labor ratio has declined. He tried to confer the message that the management in agriculture escaped the attention of policy makers and scientists,

and the role of rural women was ignored. Therefore, inter and intra-regional disparities in agricultural development have created serious social and political repercussions.

Kumar and Molana (1992) attempted to examine the extent and consequences of instability and regional disparities in the growth of agricultural output in selected Indian states for the period 1969-70 to 1983-84. The states were grouped into four regions for convenience. Results indicated that the new agricultural strategy emphasizing the introduction of high yielding varieties of seeds in the regions endowed with input resources, particularly assured irrigation, might in fact have contributed to the further widening of the regional differences. There are large scale inter-regional differences and inter-temporal fluctuations in the existing agricultural growth and there is also likelihood of such disparities affecting the aggregate performance of the sector adversely.

Singh and Markana (1992) studied the distribution of draught animals, their density and the magnitude and observed that the composition of the draught animal population differs between regions according to economic and agro-climatic features. The analysis revealed wide disparities in the distribution of draught animals, particularly bullocks, in different agro-climatic regions of the state.

Tiwari (1992) pointed out the process whereby India, by means of the Green Revolution, has been transformed into a country self-sufficient in grain and an important food exporter. It provided the background to this revolution, assessing the role of technology, fertilizer, land tenure, infrastructure and government planning. It admitted that the impact of the Green Revolution on

crops has not been uniform. The seed-water-fertilizer combination requires good land control and water management that is more feasible with rabi (winter) crops than with kharif (rainy season) crops. Only wheat, rice and maize have had substantial gains in area. There are marked regional and intra-regional disparities.

Awasthi (1993) found wide disparities in education between urban and rural areas, although the Indian education system is one of the largest in the world. Many adults as well as children in the rural areas were not in a position to make use of the educational opportunities available. Gender disparity was also an important factor. It is widely recognized that a change in the situation of women holds the key to social transformation including educational development in India. There were also wide regional disparities between, at one end, some districts in Rajasthan, Uttar Pradesh, Madhya Pradesh and Bihar where the literacy rate was 7.15 per cent with female literacy at 3.7 per cent, and districts such as Ernakulum in Kerala where literacy is 100 per cent.

Chaudhary (1994) analyzed regional agricultural growth in Pakistan in the light of the regional spread of the Green Revolution and its impact on productivity and output growth of this sector. The spread of the Green Revolution was analyzed through the adoption of high yielding varieties of seeds (wheat and rice), the consumption of fertilizer, the use of pesticides, irrigation and water supply, and agricultural credit. He found that the regional inequality in the spread of the Green Revolution has led to further inequalities, for example in income, social tension and political unrest. He suggested that

analyzing the regional differences in agriculture is important for future agricultural expansion and policy formulation.

Dholakia (1994) concluded in terms of a study of 20 Indian states over the period 1960-61 to 1989-90 that there were marked tendencies of convergence of long term economic growth rates for the states. He identified 1980-81 to be the year of break in the trend of real incomes of Indian states. Several of the lagging states started growing after this date while the leaders began to stagnate.

Pal (1995) examined empirically the extent and time-pattern of changes in inter-district disparities in overall and sectoral economic development in West Bengal during the period 1960-61 to 1980-81. In measuring the extent and pattern of inter-district disparities on the basis of selected development indicators, an attempt has been made to modify Kendall's method to take into account changes in the level of development over time. The nature of inter-temporal changes (sectoral and overall development) with regard to the relative position of the districts was analyzed by ranking the districts on the basis of indices and regional grouping of the districts. While state-level development (measured by the overall composite index) recorded an upward trend, inter-district disparities (measured by the coefficient of variation) have continued to persist. All sectors recorded development during the period. Development of the tertiary sector was estimated to be the highest. Inter-district imbalances were found to be high for industrial, tertiary and socio-cultural activities.

Pandey (1995) analyzed the regional level inter-census growth in numbers, compositional changes and spatial density of bovines and small

ruminants together with their contributions to the national economy of India during the period 1966-87, and tried to identify the major constraints inhibiting the growth of livestock enterprises across India. It revealed that indigenous cattle were mainly reared for use as draught animal power, with indigenous cow's milk considered as a byproduct. Buffaloes were considered the main milch animals. The Eastern region had the highest cattle density. India ranks second in the world in milk production, but daily per caput availability of milk in India is only 174 grams. He found that regional disparities existed in sheep and goat farming mainly due to varying resource endowments. The main constraints inhibiting the growth of livestock enterprises were chronic shortage of feed and fodder, lack of health care and veterinary infrastructure, and inadequate market infrastructure for livestock products.

Kuniyal (1996) drew an attention on sustainability horizons of Indian agriculture by focusing on inadequate per capita food availability, poverty and continuously depleting forest resources. Cropping intensity, crop-wise productivity and resultant combined crop productivity were analyzed to establish the status of sustainable agricultural development in particular reference to Uttar Pradesh Himalaya. Increasing population pressure has resulted in high pressure on hilly arable land. Cropping intensity was found above country as a whole. Within the study region itself, cropping intensity was of high and very high categories in every district except Uttarkashi. Moreover, poor performance of crops' yield with well marked intra-regional disparities was another aggravating problem for the declining overall productivity.

Bhalla and Singh (1997) presented the results of an analysis of state level data on area and output of 43 crops for the 30 years from 1962-65 to 1992-95. The study revealed that there was a marked acceleration in the growth rate of agricultural output in India during 1980-83 to 1992-95 as compared with the earlier periods. Furthermore, agricultural growth had become regionally much more diversified. The period 1980-83 to 1992-95 was also characterized by important cropping pattern changes away from coarse cereals towards rice and wheat cultivation on the one hand and towards oilseeds on the other. Finally, the 1980s also witnessed a widespread acceleration in per male agricultural worker productivity in many Indian states.

Desai and Namboodiri (1997) presented a framework for considering the various price and non-price factors, which are responsible for technical change within agriculture in India. Among the factors considered were government investment in research and development, inputs, credit, rural literacy, and marketing and banking infrastructure density, in addition to land reforms. It is concluded that technical change is a superior strategy compared to either extensive farming or intensive agriculture, because it increases production at reduced unit-costs/prices in real terms. It is also suggested that a policy paradigm shift needs to occur from the current 'techno-mechanical' approach to a 'behavioural' approach focus on non-price factors, such as research and development, agricultural and rural infrastructure, and land reforms.

Sharma *et al.* (1997) measured the extent of variation in agricultural development of eight mountainous states of India. These were Assam, Himachal Pradesh, Jammu and Kashmir, Manipur, Meghalaya, Mizoram, Nagaland,

Sikkim. Specifically, it examined the regional variations in the spread of new agricultural technology in terms of adoption of high yielding variety seed, and fertilizer consumption; and the trends in area, production and yield growth of major food grains (rice, maize, wheat) and non-food grain (pulses, oilseeds) crops. The study covered the period 1970-71 to 1992-93. A wide range of disparities was found to exist, particularly between the northern and eastern states. The study concluded that there is a need to enhance location-specific research and give more emphasis to agricultural extension facilities.

Sawant (1997) presented an update of growth performance of India's agricultural sector for the green revolution period. It focused on the national and state level analysis of (i) aggregate growth performance, i.e., of crop and livestock sub-sectors combined, (ii) elaborate evaluation of growth in the crop sector and (iii) emerging regional patterns of growth and diversification. The study concluded that the inter-regional spread of higher momentum of agricultural growth in India was far wider during the 1980s than in any of the preceding sub-periods in the past. The trend towards crop diversification has not been very strong but restricted to a few regions and states.

Singh *et al.* (1997) examined temporal and spatial performance of important foodgrain and non-foodgrain crops in terms area, production and yield and the factors responsible for determining yield and acreage of important food grain crops across the states and the country. The study revealed that for total food grains, as well as for all the individual food grain crops, yield witnessed a higher growth rate as compared to acreage during 1972-73 to 1992-93. It was found that increased use of irrigation water, fertilizers and HYV

seeds could further enhance the yield of food grain crops. The main determinants of agricultural performance were found to be total cropped area, yield per hectare and irrigation water, followed by regulated markets and road networks. Relatively less agriculturally prosperous states showed good potential for improving their agricultural performance. Since, there exists good scope to exploit the hitherto unexploited regions of the country to increase their agricultural performance in future.

Haque *et al.* (1998) presented the spatial patterns of agricultural development in the background of significant progress achieved in terms of both output and productivity growth during the past few decades in India. In order to adopt the available new technology for ensuring food and nutritional security for the growing population and to remove regional imbalances in agriculture, the potential for the development of rainfed areas were highlighted along with the need for location specific strategies for development. The measures required to bridge the productivity gaps between irrigated and rainfed areas were also identified. In this context, the paper dealt with issues of productivity potentials of different regions and suggests specific investment priorities for various agro-economic zones keeping in view the spatial patterns of agriculture production and their requirements.

Saikia (1998) identified and analyzed at district level the contemporary internal disparities in levels of development within India's northeastern region. District level data from 1991 for 60 districts were used from District Profiles, census and relevant official publications. Twenty-one indicators were divided into four sets, representing different aspects of development. These were levels

of resource development, levels of agricultural development, levels of infrastructure development and levels of industrial development. A composite index was derived. Five distinct levels of overall development were recognized: the highly developed capitals and gateway cities (Gauhati and Shillong) and other mainly administrative place; other administrative areas, e.g. Imphal, as well as tea and pulp settlements; the remaining three low levels which constitute most of the region, including most of Arunachal Pradesh, which was at the very bottom of a region of relatively low development. Sharp intra-regional contrasts in development level remain. The study concluded that though the need for new investment is now recognized by central government, it is important that such investments do not accentuate existing intra-regional disparities.

Singh and Goswami (1998) conducted a study to analyze agricultural growth performance in the northeastern hill region of India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura) over the period 1975-96, and the factors affecting it, revealed wide disparities in foodgrain productivity among states. Agricultural growth rates ranged from 5.70 in Mizoram to 0.35 per cent per annum in Meghalaya. This is in conflict with the objective of balanced regional agricultural growth in the country. Among the various factors affecting performance were availability of irrigation facilities, adoption of high yielding varieties (HYVs) of crops, rate of fertilizer use, credit availability and farm size. It is recommended that the major policy thrust in this context should be on enhancing irrigation facilities through a watershed approach, development of location specific HYVs of crops, intensification of

extension services, liberal institutional credit and implementation of new land reforms policy, etc.

Singh *et al.* (1998) undertook the study to estimate rate of growth and performance of agriculture in different regions of the state of Uttar Pradesh during the period 1969-70 to 1989-90 by studying the regional inequalities regarding area, production and productivity of principal crops and crop groups. They found that there has been a large variation in agricultural performance of different regions of the state, in terms of area, production and productivity of different crops. These variations were largely due to variations in the use of critical inputs i.e., irrigation, fertilizer and HYV seeds. This resulted in an imbalanced growth of agriculture. A fresh approach to the existing framework of planning for a balanced and equitable growth of different regions and crops in the State is recommended.

Srivastava (1998) made a comparative study of agriculture sector at the district level in the North Eastern Region and focused on the component approach rather than mere productivity aspects of agriculture. The study focused mainly on the inter-district disparities in agricultural development in terms of identified components of agricultural development and asserts that the productivity standards for most of the crops are much higher in the multiple and mixed cropping system practiced under the shifting cultivation system in the hill districts where land is scarce when compared to mono-cropping system prevailing in the naturally advantageous areas of Assam. It was found that per hectare productivity of land is higher in the districts where nature has been harsh in terms of arable land. The study highlighted the importance of two very

important aspects of natural resource management, namely, land has been managed best where it is most scarce as reflected by higher overall productivity, and inter-cropping and mixed cropping can provide a solution to the ever-growing food requirements.

Kohli *et al.* (1999) constructed nine composite indices to represent the development pattern by using secondary data for the year 1991 of Rajasthan's tribal sub plan (TSP) area. These were a demographic index, geophysical index, agricultural infrastructure and input index, social infrastructure index, economic infrastructure index, financial index, agricultural productivity index, industrial index, and a quality of life index. The indices showed that there were differences between tehsils in the levels of development within the TSP area and that regional policy needs to be sensitive to these disparities.

Joshi *et al.* (2001) studied agricultural performance in semi-arid tropics of India. The study attempted to determine the factors, which promoted or retarded the agricultural performance. Three key areas were investigated that included new technology, infrastructure and socio-economic factors. A number of relevant components were identified under each key factor, which explained the sources of agricultural performance differences in semi-arid tropics. They concluded that all indicators like agricultural income, yield levels, their stability, cropping intensity and crop diversity, selected to investigate agricultural performance revealed large variations in them within the semi-arid tropics region. The variation in agricultural performance was largely due to differences in agricultural potential, which was influenced by the uneven endowments of natural resources, besides lack of diffusion of improved

technology, inadequacy of bank credit and other infrastructures, and low status of socio-economic factors especially literacy.

2.3 Application of Principal Component Analytical Tool

In this section, those studies have been reviewed which have used the principal component analytical tool as a measure for the performance of agricultural components.

Nieuwoudt (1977) studied the physical efficiency criteria such as calving and lambing percentages for 91 farmers in a homogeneous farming area by the principal component analysis. The first component implied that a farmer achieving a high score in one efficiency criterion also achieves high scores in other criteria. This component, called a 'performance index' showed a common association with financial success in farming. This 'performance' factor can be included in the routine computer printouts of farm records and could furnish additional information concerning management at no extra cost. This might be served as an encouragement to farmers to adopt better farming practices.

Routray and Patnaik (1981) studied the variation in the levels of agricultural development in different districts of Orissa, between 1961 and 1975-76 and the possible causes for such variations were identified with a view to suggesting a set of corrective measures to reduce the gap in agricultural development between districts. The levels of agricultural development was studied on the basis of the following five indicators of development: agricultural labor productivity, agricultural land productivity, intensity of cropping, proportion of irrigated area to total net cropped area, and consumption of

chemical fertilizers. Principal component analysis was used to construct a composite index of agricultural development. The whole set of data was normalized by taking logarithms and the standardized data were taken for the computation of an inter-correlation matrix. The pattern of agricultural development in different time periods has been shown to be very similar with little variation between places. Four distinct agricultural regions were identified: (a) advanced, (b) developed, (c) underdeveloped, and (d) problematic. The study concludes that the new agricultural practices for better development will certainly involve the adoption of a new cropping pattern on the basis of agro-climatic conditions and particularly with emphasis on the efficient utilization of available water resources for irrigation purposes.

Seshachalapati and Rao (1986) used principal component analysis to estimate the linear production functions for the following inputs: extent of land used, expenditure on chemical fertilizers, expenditure on manures, tractor hours utilized, bullock-pair days (8 hour units) used, and human labour (8 hour) man days. The results were used to highlight distortions resulting from multicollinearity in respect of the data on "Incomes, Savings and Investments" survey conducted by the Agro-Economic Research Centre, Andhra University, Waltair. The standard errors of the estimates of the original parameters thus obtained were computed using simulation techniques. Hence, the study has demonstrated the use of principal component approach when multicollinearity is present in the estimation of commonly used agricultural production functions. Although the computational burden increases in the principal component

approach, the results of the analysis are seen to exhibit a proper understanding of the structure of agricultural production relationships.

Kalla *et al.* (1988) analyzed the development process by district in the state of Rajasthan using 14 determinants of the development process through the principal component approach. The data on the specified determinants were collected for the three discrete mean points of time viz., means of 1966-69, 1970-73 and 1974-77 for each district of Rajasthan state. Agricultural development is considered a precondition for enhanced productivity, gainful employment and human resource base in the agricultural sector. However, in a large country like India regional resource endowments are too varied to make any generalization about the development process. The results showed that of the 26 districts, five districts each could clearly be categorized into highly advanced, advanced, medium advanced, low advanced, and very low advanced. The results conclusively suggest gearing development planning towards creating favourable resource endowments in six arid (Barmer, Churu, Jaisalmer, Jalore, Jhunjhunu and Sikar), three semi-arid (Dungarpur, Bundi and Sirohi) and two sub-humid (Banswara and Jhalawar) districts in order to remove regional imbalances.

Reddy and Reddy (1993) examined agricultural development in Andhra Pradesh state by the principal component analysis and factor analysis. They have taken into consideration as development indicators the following variables: percentage of gross irrigated area to gross sown area, cropping intensity, irrigation intensity, percentage of area under high yielding varieties to gross sown area, consumption of fertilizers per 1000 ha of gross sown area, number of

pumpsets per 1000 ha of net irrigated area, and number of ploughs per 1000 ha of net sown area. Hyderabad and West Godavari emerged as very highly developed districts and thirteen districts remain backward.

Iyenger and Basak (1994) have used principal component analysis to identify regions in India with homogeneous variability of monsoon rainfall. The data considered were the seasonal monsoon rainfall total (June September) of 200 stations for 80 years (1901-80). Four main regions (principal regions) were first defined. These were uncorrelated and represented four independent monsoon anomaly patterns. The largest principal region accounted for 45 per cent of the area. Ten sequential regions were identified using a hierarchical approach. These accounted for 91 per cent of the total land under consideration. The temporal and inter-annual variability of rainfall was considered.

Prakash *et al.* (1994) used principal component analysis to analyse the factors affecting capital formation in rainfed and irrigated areas of Mysore district of Karnataka state. Data were collected from a sample of 56 irrigated and 56 unirrigated farms in less progressive taluk Mysore and progressive taluk Nanjanagud for the period 1983-84 to 1988-89. The results revealed variations across groups. For irrigated farms, size of holding, education and savings were important determinants of capital formation, while net income, education and age had an effect on capital formation on unirrigated farms. Credit was not found to be significant. The results suggest that educated farmers better perceive the importance of farm assets.

Manjula *et al.* (1994) investigated how various factors contribute to the adoption behaviour of trained and untrained farm women based on the

experience of a 10-day training programme conducted for the farmwomen of Bangalore district, Karnataka, by the Farmers' Training Institute of the University of Agricultural Sciences, Bangalore. Forty trained and forty untrained women were included in the sample. Adoption levels were measured with reference to 11 selected recommended groundnut cultivation practices. The results showed training to be more effective, resulting in better adoption, by selecting farm women who are the older members of the family as they have higher achievement motivation. There is also a need to follow up the training with extension support on the farm. In order to promote adoption among untrained farmwomen, there is a need to enhance their organizational participation and extension participation as these factors were found to have a bearing on their adoption behaviour.

Sarker (1994) studied the link between regional imbalances and plan outlays based on 15 Indian states. He discovered a strong link between development measured in terms of 14 variables including per capita consumption of electricity, percentage of villages electrified, per capita expenditure on health, effective literacy rates, etc. and the per capita plan outlays for the different states. He employed principal component analysis to construct a composite index of development according to which Punjab scored the highest and Bihar the lowest.

Kunnal *et al.* (1995) evaluated the performance of the Karnataka State Seeds Corporation (KSSC) by employing the principal component analysis technique. To analyze the performance of the KSSC, time series data were abstracted from the annual reports of the KSSC for the period 1978-79 to 1989-

90. In all 26 performance indicators, 5 physical and 21 financial were identified to have close association with the performance of the KSSC. The three principal components had the eigen values more than one. The first component, which explained 84.04 per cent of the total variation, while the second and third explained 5.18 and 4.56 per cent respectively. The first component extracted all the five physical variables and the financial variables related to the assets and liabilities and income and expenditure of the corporation. It was identified that infrastructure and volume of business were the most influencing indicators of the performance of the corporation. They concluded that the KSSC is needed to run on profitable lines by providing all types of seeds needed by the farmers that indirectly contributing to the agricultural development of the state.

Shaban and Bhole (2000) analyzed the regional disparities in rural development in India by using seventeen indicators of development and principal component analysis (PCA), cluster analysis and other statistical methods. They attempted to measure inter-state differentials in rural development in India at various indicators, principal components, and aggregate levels of development for the year 1991-92. The study found that rural development in India is regionally imbalanced one and inter-state disparities are very high. Out of the 17 development indicators, 14 have coefficient of variation above 20 per cent, 9 have coefficient of variation above 40 per cent, and 4 have coefficient of variation above 80 per cent. At the aggregate level of development Punjab is the most developed state followed by Haryana, Kerala, and Karnataka while the least developed State is Bihar followed by Orissa, U.P. and Assam.

The different studies reviewed, have investigated extensively on the basis of objectives and analytical procedures, which have employed in this study. It is unanimously accepted through the review of various studies that wide variations exist among the different potential factors, which are considered for agricultural development. The present study is carried out to identify inter-state disparities in agricultural development across the states and all India. Further, in this study the maiden attempt has been made to construct the composite index of agricultural development, which is based on an optimum combination of multiple indicators. In addition, the major states and all India have been classified in different categories according to their stages of agricultural development. Besides, this study identifies the potential factors and analyses which of the factors significantly contribute to agricultural development across the states. Hence the findings of the study will help to formulate proper policy to promote balanced agricultural development of the country.

CHAPTER III

THE ANALYTICAL FRAMEWORK AND DATA

The present study looks at the status of inter-state disparities in agricultural development in India. The specific objectives have been framed for empirical analysis of disparities in level of agricultural development. In this chapter, procedures adopted for data collection and analytical techniques used for analysis have been explained. A macro level study based on state level time series data has been designed to achieve the objectives of this study. Therefore, this chapter makes available an inception about data and their sources, specification of agricultural development indicators and analytical approach to the problem.

3.1 Data and their Sources

The analysis of inter-state disparities of agricultural development and the factors of development involve multiple variables, and falls in the domain of multivariate analysis. Operationalization of analysis of multidimensional concept of development implies application of statistical models to the empirical situation. However, application of models and techniques entail certain issues. These are concerned with the availability of data, unit of analysis, selection of variables and techniques of analysis. Following sections consider the theoretical and the practical aspects of these issues.

Data Base

The study is based on state level time series data, which are published by the different organizations and institutions. The availability of time series data

related to agricultural development parameters have been taken as time boundary of this study. For this study, the period is taken from 1970-71 to 1996-97 and the data have been collected for 17 major states and all India that states covered at least one percent of reporting area as percentage of all India's reporting area.

The data on different parameters have been collected from various sources as given below:

1. Indian Agricultural Statistics, Government of India
2. Indian Agriculture in Brief, Government of India
3. Agricultural Statistics at A Glance, Government of India
4. Bulletin on Food Statistics, Government of India
5. All India Livestock Census Report, Government of India
6. Statistical Abstract – India, Central Statistical Organization
7. Fertiliser Statistics, The Fertiliser Association of India
8. Statistical Statements Relating to Cooperative Movement in India, National Bank for Agriculture and Rural Development (NBARD)

The data have also been taken from research publications of Pal and Singh (1997) and Fan, Hazell and Thorat (1999).

3.2 Selection of Agricultural Development Indicators

Agricultural development is a multidimensional concept that comprises agricultural, infrastructural and socio-economic factors. Hence, development can be measured as a process or as a state or in terms of conditions necessary for development (Munir, 1992). Since, the temporal and spatial pattern of agricultural development at the state level is a dynamic process, which may not be restricted only to some selected variables or parameters. But, it is necessary to recognize the important indicators for quantifying the status of development

and to examine the relative importance of the parameters into the developmental process. In view of this, twenty-two variables are selected as the agricultural development indicators that could be broadly classified into three groups, namely, agricultural, infrastructural and socio-economic variables. The brief depiction of the indicators of agricultural development under these categories is sketched below.

3.2.1 Agricultural Variables

The agricultural variables are directly related to agricultural mechanism, which are most dominant factors for agricultural progressiveness. The advent of HYVs of improved seeds, water and fertilizer management ushered in the era of Green Revolution in agriculture. Hence, the importance of these factors in agricultural development is well documented. In this study, the following indicators are considered as agricultural variables.

Cropping Intensity

Cropping intensity is given by the ratio of the total cropped area to total cultivated area and is expressed in percentage form. It measures the capacity of land to grow crops in a year. It varies from state to state, due to variation in physical conditions and availability of infrastructural facilities, which are more essential for growing crops more than once. Since, it accounts for the land utilization potentiality it is most vital for agricultural development.

Irrigation Intensity

Irrigation intensity is expressed by the ratio of the gross irrigated area to net irrigated area and measures the capability to use the irrigation facilities that is articulated in percentage form. It clearly gives an idea about the efficiency of

irrigation technology and is one of the most important factors affecting agricultural development, because it ensures the efficient use of modern technology round the year. Multiple cropping facilities, intensive and effective use of land and higher production can be achieved through irrigation and is captured through the irrigation intensity. In view of its importance, irrigation intensity has considered as an indicator of agricultural development.

Net Sown Area

Net sown area shows how much land is available for cultivation purpose. It mainly depends on the topography of area and physical situation of the land. The favorable physical condition is the prime need for any kind of development. Net sown area as percentage of total reported area has been considered as an indicator.

Net Irrigated Area

Irrigation is one the major component of Green Revolution packages, which is essentially needed for assured the effect of other components also and boost up the agricultural crop productivity. So, assured irrigation facilities not only help in increasing crop productivity but also its availability is a pre-condition for application of other productivity increasing inputs of new agricultural strategy (Sadhu and Mahajan, 1985). Hence, extent of irrigation network as reflected as net irrigated area as percentage of net sown area.

Area under High Yielding Varieties

This includes the total area under high yielding varieties (HYVs) of 6 major cereals – paddy, wheat, maize, sorghum, pearl millet and ragi. The widespread adoption of HYVs shows the most significant changes in agriculture

in recent decades but is not evenly distributed throughout the country. In the analysis, the area under HYVs is taken as percentage of total area sown under these crops.

Fertilizer Consumption

Fertilizer consumption relates to the consumption of total nutrients (N+P₂O₅+K₂O) that is the critical input for agricultural production and is an integral part of the new agricultural technology. It helps in providing the nutrients needed for plant growth. As a result, productivity of agricultural crops is boosted up even in short period. Nevertheless, it is also one of the leading inputs for achieving breakthrough in the agricultural production in the country, even here, there is a wide variation in the per hectare use of fertilizers amongst the states. In this study, fertilizer use in kilogram per hectare of gross cropped area is taken as an indicator.

Foodgrain Productivity

Though, foodgrain productivity is the ultimate result of the use of modern inputs, which largely varies across the regions and creates the disparities in agricultural development. In spite of this, it ensures the food availability to the people and the self-sufficiency in food in the country that finally helps to promote the agricultural development. It is taken as kilogram of foodgrain produced per hectare of gross cropped area.

Agricultural Workers

Agricultural workers are required to accomplish the agricultural activities in all the steps of production process. But, it is quite explicit that there is wide variation in number of agricultural workers among states. Agricultural

workers data is available from the decennial population census. Therefore, it was interpolated and extrapolated to make time series data for the inter-census years for states and also for all India. Agricultural workers per thousand hectares of gross cropped area in the state is taken as an indicator.

Livestock Density

Livestock is the integral part of the agricultural economy in this country. The Indian farmer uses cattle for all agricultural operations – such as for ploughing, for lifting water from wells, for threshing, for carrying the produce to the market, etc. In fact, farmers depend on cattle to carry on their cultivation and it has vital role in agricultural development. Livestock data is available through the livestock census that has been reported on quinquennium basis. Hence, the time series data have been generated through the interpolation and extrapolation of the livestock data of the state. Livestock density per hundred hectares of gross cropped area has been taken as an indicator of agricultural development.

3.2.2 Infrastructural Variables

Infrastructural development stimulates and sustains the agricultural development and provides the opportunity for commercialization of agriculture, and commercialization of agriculture increases economic development. The transition from subsistence to commercial farming is inevitably linked with the development of infrastructural facilities. Hence, the development of infrastructural facilities and their efficiency of operation are closely linked with the overall agricultural development. The following indicators are included as infrastructural variables.

Pumpset

Water is the key factor in agricultural development as it increases not only the intensity of cropping but also brings about more and more culturable wastelands under the plough. It is applied through different modes from different sources but pumpset is the most important hardware to irrigate the land. But considerable regional variation still exists in case of number of pumpset amongst the states. The total number of pumpset data is available in the livestock census report that is published on quinquennium basis. Hence, the time series data have been created by the interpolation and extrapolation methods. Number of pumpset per ten thousand hectares of net-cropped area has been taken as an indicator of infrastructure development.

Tractor

Tractor is the major equipment for transforming traditional agriculture into mechanized form. It helps to speed up all types of farm operations and reduce the problems of agriculture such as labor and draft power shortage, particularly on large farms and at peak time. If tractor facilities are available at least the percentage of cultivated area may be expected to increase and so the agricultural production. The total number of tractors data is also available in livestock census report on quinquennium, which is interpolated and extrapolated to generate the time series data for the states and all India. The number of tractors per ten thousand hectares of net cropped area has been considered as an indicator of agricultural development in the state.

Regulated Market

The regulated markets play a vital role in the agricultural development by controlling the distribution system, which may be of different kinds and levels. A regulated market functions under law either for a specific commodity or for a group of commodities. Such a market is administered by a market committee, which consists of representatives of the State Government, the local bodies, the traders, the commission agents or the dalals and the farmers themselves. The committee is appointed by the government for a specific period and is entrusted with the management of the market. They have helped to secure fair prices to the farmers for their produce and come to the market without their usual fear. They have helped the use of standard measures and weights throughout the country (Singh and Fazal, 1998). The number of regulated market per ten thousand square kilometer geographical area of the state is taken as an indicator of agricultural development.

Electrified Villages

Electrification is most important to provide the modern amenities at the village level. The modern amenities help to disseminate the present development and knowledge to the rural people. Electrification is essential requirement for using the contemporary tools and equipments in agriculture. So, electrification of villages accelerates in agricultural development. In this regard, electrified villages as percentage of total villages is counted as an indicator of agricultural development.

Electricity Consumption in Agriculture

A very small proportion of total electricity consumption is used for agricultural purposes, although it has significant impact on agricultural development. Therefore, electricity consumption in agriculture as percentage of total electricity consumption has been taken as an indicator of agricultural development.

Density of Rural Roads

Rural road is the key element for communication at the village level. Without proper communication it may not be possible to get all types information, such as, price of the commodity, availability of required inputs, etc. Moreover, it provides the easy transportation facilities that help to promote marketing of rural produce and add place utility. Thus, the transportation network is the arteries and the veins through which the lifeblood of rural economy circulates. In fact, it has great importance for developing agriculture as well as rural industry. Hence, density of rural roads is measured as the length of roads in kilometers per thousand square kilometers of geographical area in the state.

Primary Agricultural Cooperative Society

The cooperative structures have a three-tier structure in India where the primary agricultural cooperative societies represent the lowest level and function at village based. At a village level, ten or more than ten persons can establish cooperative society, such societies advance loans for production purpose only (Joshi, 1992). Since, the primary agricultural cooperative societies play a pivotal role to supply credit to the farmers through the institutional

sources. Number of primary agricultural cooperative societies per thousand square kilometer of geographical area in the state is taken as an indicator of agricultural development.

3.2.3 Socioeconomic Variables

Socio-economic environment is driving force of the society and it helps in decision-making process and to judge everyday matter. So, the acceptability of any technology and adoption in agriculture is greatly influenced by the socio-economic factors. Hence, it is recognized that the socio-economic factors promote agricultural development. The following indicators have been chosen under this category.

Rural Literacy

Education plays a pivotal role in development process in India, where most of the people are living in rural areas there is basic need for development of rural education because education is the backbone of a nation. The literacy rate in rural India has increased steadily, but with great regional variation (Fan et al. 1999). Literacy enables to improve efficiency of farming is obvious as it enables farmers to be more scientific in the application of various inputs (Desai and Namboodiri, 1997). As regards, the data for rural literacy are taken from Fan, Hazell and Thorat (1999), and rural literacy rate as percentage of total population is taken as an indicator.

Net Value of Agricultural Production

Net value of agricultural production is related with the price and production of the commodity and it measures the profitability of the farm enterprise. Both price and production are positively interrelated with each other

that are also supply instrument of a commodity, however, production also depends on productivity. Due to variation in price and productivity, agricultural income varies largely across the states. Since, net value of agricultural production takes care of price and productivity, which are most important for agricultural development. It is taken as per hectare net value of agricultural production in rupees.

Expenditure on Agricultural Research and Education

The national agricultural research and education system is coordinated, directed and promoted by the Indian Council of Agricultural Research (ICAR) and dominated by the public investment. Pal and Singh (1997) found that the trends in total government investment in research and education showed the impressive growth in case of central and state governments and also that the real investment per hectare of gross cropped area increased overtime. Moreover, they reported that the wide variations exist across the state, though real investment has increased overtime in the states. The investment in agricultural research and education is one of the major successive components for spectacular development in agriculture. The Government investment in agricultural research and education data is taken from Pal and Singh (1997) and converted as expenditure on agricultural research and education per hectare of gross cropped area in rupees.

Expenditure on Extension

Extension activities are essential for demonstration of the modern technologies of agriculture, which disseminate the knowledge to the farmers. Ultimately, it helps to influence the farmers regarding technology and identify

the problems of farmers in the field level. Thus, it works with two-way approach in the development process and directly links with rural people with scientists. Owing to this concern, expenditure on extension in rupees per thousand of rural population has been taken as an indicator. For this, the data on total expenditure on extension has been taken from Pal and Singh (1997).

Share of Agriculture in Net State Domestic Product

Net domestic product accruing from agriculture indicates the contribution of agriculture in the economy. Though, it has shown decreasing trend as the other sectors are growing faster than agriculture. Since, share of agriculture in net state domestic product (AgNSDP) has considered as percentage term.

Per Capita Agriculture Net State Domestic Product

A part of the agricultural income is used for crop production and other agricultural activities for capital investment. Capital is foremost condition for any kind of investment or adoption of modern technologies and it works as the prime factor of development. Thus, per capita AgNSDP has been considered as one of the indicators of agricultural development.

3.3 Analytical Technique

The analytical technique part is a crucial element for the research work that should be easily understandable and relevant with the objectives. In view of this, it is tried to sketch out the techniques used to achieve the objectives.

3.3.1 Construction of Composite Agricultural Development Index (CADI)

Literature offers a variety of methods to compute simple and composite indices ranging from simple unweighted or simple equal-weighted to much sophisticated multivariate statistical techniques. Each set is designed to serve a particular purpose and highlight a specific aspect. Consequently, one can always trace merits as well as shortcomings of any chosen index (Sharma and Mahajan, 1996). Hence, it has been emphasized the spatial aspects of agricultural development by proposing a simple method for measuring the level or stage of state agricultural development. This method is a simpler and probably a better alternative to the conventional approaches (Moris and Liser, 1977, Mukherjee, 1980, Iyenger and Sudarshan, 1982).

In order to examine, the inter-state disparities in agricultural development across the states and over time CADI has been constructed based on the 22 agricultural development indicators and the triennium central average data considered for the analysis as a weighted approach. Because, the data are so flexible and large variability is presence that could not be reflecting the authentic agricultural development of the states. Needless to mention that agricultural development is a combined effect of so many factors, which are very difficult to be isolated. Only those indicators have been considered that are very important and are highly relevant to agricultural development and also depending on availability of data were chosen. One might also argue that some of the indicators employed in this study are superfluous, but this argument does not hold water when one recognizes, for example, that the percentage of villages electrified reflects the rural development aspects, whereas it creates also

opportunity to spread and use the modern agricultural tools and implements which is essential for agricultural development. Hence, development being a complex multi-dimensional phenomenon, one cannot altogether avoid using different indicators, simultaneously, which may appear redundant at first sight and which may in fact be not quite so.

Consequently, the procedure essentially calls for selection of appropriate development indicators; conversion of the original values of the indicators into some scaled values; and construction of the composite indices by taking the weighted sum of the scaled values. The steps involved in the computation of composite index of agricultural development are as follows:

Firstly, the selected indicators data have been transformed in the scaled values by the following equation:

$$y_{is} = \frac{X_{is} - \text{Min}(X_{is})}{\text{Max}(X_{is}) - \text{Min}(X_{is})} \quad (1)$$

where, $i = 1, 2, 3 \dots \dots \dots, n = 22$ indicators of agricultural development;

$s = 1, 2, 3, \dots \dots \dots, N = 17$ major states and all India;

y_{is} = scaled value of the i^{th} indicator in the S^{th} state;

X_{is} = value of the i^{th} indicator in the S^{th} state

$\text{Min}(X_{is})$ and $\text{Max}(X_{is})$ are, respectively, the minimum and maximum values out of $X_{i1}, X_{i2}, \dots \dots \dots X_{iN}$.

If, however, X_i is negatively associated with development then above can be written as:

$$y_{is} = \frac{\text{Max } (X_{is}) - X_{is}}{\text{Max } (X_{is}) - \text{Min } (X_{is})} \quad (2)$$

For the present analysis, it has been postulated that all indicators are positively associated with agricultural development. Obviously, the scaled values, y_{is} , vary from zero to one.

Secondly, from the matrix of scaled values $Y = ((y_{is}))$, the measure for the level of agricultural development for different states and all India has been constructed as follows:

$$\bar{y}_s = w_1 y_{1s} + w_2 y_{2s} + \dots + w_n y_{ns} \quad (3)$$

Where, the w 's ($0 < w_i < 1$ and $w_1 + w_2 + \dots + w_n = 1$) are arbitrary weights reflecting the relative importance of the individual indicators. A special case of this will emerge if the weights are assumed equal.

However, a more rational view has been taken by assuming that the weights vary inversely as the variation in the respective indicators of agricultural development. More specifically, it assume:

$$w_i = \frac{m}{\sqrt{\text{Var } (y_i)}} \quad (4)$$

$$\text{where, } m = \left[\sum_{i=1}^n \frac{1}{\sqrt{\text{Var } (y_i)}} \right]^{-1} \quad (5)$$

The overall state index, \bar{y}_s , also varies from zero to one. Also, if y_1, y_2, \dots, y_n are independent, then

$$\text{Var}(\bar{y}_s) = \sum_{i=1}^n W_i^2 \text{Var}(y_i) \quad (6)$$

The choice of the weights in this manner ensures that large variation in any one of the indicators will not unduly dominate the contribution of the rest of the indicators and distort inter-state comparisons. It may be recalled that Hellwig along with several others preferred this method (Iyenger, Nannjappa and Sudarshan, 1981). It is also well known that, in statistical comparisons, it is more efficient to compare two or more means after equalizing their variances. It may be reiterated that all essential facets of agricultural development have gone into the making of these indices. Therefore, without loss of generality, one can comment on the character of agricultural development on the basis of these results.

By using the above approach the state indices have been constructed for all the major states and all India since 1971-72 to 1995-96 that clearly indicate the dimension of disparities at temporal and spatial level in agricultural development. Furthermore, the indices have been used to classify the states in different categories at five years interval periods. The adopting classificatory approach has been dealt in detail in the next section.

3.3.2 Classificatory Approach

Generally, a simple ranking of the state indices would help to compare the level of agricultural development across the states. However, a more meaningful characterization of the different stages of agricultural development would be in terms of suitable fractile classification from an assumed distribution of the mean of CADIs (\bar{y}). It appears appropriate to assume that the mean (\bar{y}) has a Beta distribution in the range zero to one. The Beta distribution is generally skewed, and is relevant to characterize positive-valued random variables.

A random variable, Z has a Beta distribution in the interval (0,1) if its probability density function f(z) can be written as (Abramowitz and Stegun, 1970):

$$f(z) = \frac{1}{\beta(a, b)} z^{a-1} (1-z)^{b-1} \quad 0 < z < 1 \text{ and } a, b > 0 \quad (7)$$

where, $\beta(a, b)$ is the integral.

$$\beta(a, b) = \int_0^1 z^{a-1} (1-z)^{b-1} dz \quad (8)$$

Let (0, z₁), (z₁, z₂), (z₂, z₃) and (z₃, 1) be linear intervals, such that each interval has the same probability weight of 25 per cent. These quartile groups can be used to characterize the various stages of agricultural development. In this study, the states have been classified into four groups based on level of agricultural development as defined below:

- A. Less Developed States if $0 < \bar{y}_S \leq z_1$
 B. Developing States if $z_1 < \bar{y}_S \leq z_2$
 C. Moderately Developed States if $z_2 < \bar{y}_S \leq z_3$
 D. Developed States if $z_3 < \bar{y}_S < 1$

The parameters (a, b) in the assumed Beta distribution can be estimated

by solving the simultaneous equations:

$$\begin{aligned} (1 - \bar{y}) a - \bar{y} b &= 0 \\ (\bar{y} - m_2) a - m_2 b &= m_2 - \bar{y} \end{aligned} \quad (9)$$

where, \bar{y} is the overall mean of the state indices and m_2 is given by

$$m_2 = S_y^2 + \bar{y}^2 \quad (10)$$

Where, S_y^2 is the variance of the state indices. The cut-off points z_1 to

z_3 can be obtained from tables of incomplete Beta function or from table of the

F-distribution with degrees of freedom (2a, 2b), which are readily available.

If $F_{n_1, n_2; p}$ is the value of the F-Statistic with n_1 and n_2 degrees of

freedom corresponding to probability p, i.e.,

$$\Pr(F \leq F_{n_1, n_2; p}) = p \quad (11)$$

then,

$$F_{n_1, n_2; p} = \frac{n_2}{n_1} \frac{1 - Z_p}{Z_p} \quad (12)$$

where, Z_p is the p^{th} fractile of the corresponding Beta distribution.

$$Z_p = \frac{1}{1 + \frac{b}{a} F_{n_2, n_1; p}} \quad (13)$$

since, $n_1 = 2a$, $n_2 = 2b$.

Extensive tables are available for computing the fractile points on the F-distribution for selected values of (n_1, n_2) and p (Pearson and Hartley, 1976). For values of F not readily available in the tables a two-way interpolation is needed. A straightforward procedure would be as follows:

For values of p less than 0.5, let $F_{n_{2k}, n_{1k}}$ be the tabulated value of the F-ratio with degrees of freedom (n_{2k}, n_{1k}) for a given fractile point on the distribution. Taking $k = 1$ and $k = 2$, F_{n_2, n_1} is computed for values of (n_2, n_1) .

Where, $n_{21} < n_2 < n_{22}$ and $n_{11} < n_1 < n_{12}$.

The interpolation formula is given as:

$$F_{n_2, n_1} = F_{n_{21}, n_{11}} + \frac{n_2 - n_{21}}{n_{22} - n_{21}} (F_{n_{22}, n_{11}} - F_{n_{21}, n_{11}}) + \frac{n_1 - n_{11}}{n_{12} - n_{11}} (F_{n_{21}, n_{12}} - F_{n_{21}, n_{11}}) + \frac{(n_2 - n_{21})(n_1 - n_{11})}{(n_{22} - n_{21})(n_{12} - n_{11})} [F_{n_{21}, n_{11}} + F_{n_{22}, n_{12}} - F_{n_{21}, n_{12}} - F_{n_{22}, n_{11}}] \quad (14)$$

However, for $p > 0.5$ the following result holds:

$$F_{n_1, n_2; p} = \frac{1}{F_{n_1, n_2; 1-p}} \quad (15)$$

Hence, the above calculation has been done to estimate the Z_p which is the p^{th} fractile of the corresponding Beta distribution and according to the Z_p value the states are placed in different categories of agricultural development as mentioned previously.

3.3.3 Principal Component Model

The Principal Component Analysis (PCA) has been used to identify the most potential indicators, which can capture most of the variability in the explanatory variables on the performance of agricultural development as well as to measure the contribution of the indicators.

The beginning of principal component analysis is probably to be found in the work of Karl Pearson (1901). Hotelling (1933) investigated in detail the statistical properties of principal components. Anderson (1958) has given the most comprehensive exposition of it.

PCA is a mathematical technique that summarizes high dimensional data into a few dimensions, while retaining most of the variation present in the data set. The original data are transformed into a set of new properties called Principal Components (PCs), which are linear combination of the original variables (Jolliffe, 1986; Kendall, 1980; Koutsoyiannis, 1978). The PCs are mutually uncorrelated and captures maximum variance. The first principal component accounts for as much variation in the data as possible. Each succeeding principal component accounts for as much, of the remaining variation unaccounted for by preceding principal components, as possible.

The aim of the method of principal components is the construction, out of a set of variables, X_j 's ($j= 1, 2, . . . , m$), of new variables (P_i) called principal components, which are linear combinations of the X 's. The calculations of coefficients (weights a 's), which are used to transform the X_j 's into orthogonal artificial variables, require the simple correlation coefficients

between m explanatory variables. In fact, PCs may be obtained by using correlation matrix or covariance matrix (Johnson and Wichern, 1988, Jolliffe, 1986). In this study, PCA has been done through the correlation matrix and the data have been considered as standardized form to construct the PCs.

The systematic technique is as follows:

The following technique has been used to workout PCs in this study.

First, the correlation matrix for explanatory variables has been worked out. Let this matrix be $[A]_{m \times m}$ with ' m ' number of explanatory variables. Then, the solution of following set of ' m ' equations yield ' m ' different values of characteristic roots these are also known as latent roots or eigen values, denoted as ' λ '.

The characteristic equation is

$$(A - \lambda I) = 0 \quad (16)$$

where, A = Correlation matrix of size $m \times m$

I = Identity matrix of size $m \times m$

λ = Scalar

Let these characteristic roots or eigen values be denoted as $\lambda_1, \lambda_2, \dots$
 $\dots \dots, \lambda_m$ in descending order. Corresponding to each characteristic roots or eigen values (say λ_j) a characteristic vector or eigen vector (a_j) of size $m \times 1$ has been worked out by solving the following matrix.

$$(A - \lambda_j I) (a_j) = (0) \quad (17)$$

where,

$A = m \times m$ correlation matrix as defined earlier

$\lambda_j = \text{Scalar}$

$I = m \times m$ identity matrix

$a_j = m \times 1$ column vector

$0 = m \times 1$ vector of zeros.

Similarly, characteristic vectors or eigen vectors corresponding to other roots have been worked out. The principal components corresponding to characteristic roots are then defined as:

$$\begin{aligned}
 P_1 &= a_{11} Z_1 + a_{12} Z_2 + \dots + a_{1m} Z_m \\
 P_2 &= a_{21} Z_1 + a_{22} Z_2 + \dots + a_{2m} Z_m \\
 &: \quad : \quad : \quad : \quad : \\
 &: \quad : \quad : \quad : \quad : \\
 P_m &= a_{m1} Z_1 + a_{m2} Z_2 + \dots + a_{mm} Z_m
 \end{aligned} \tag{18}$$

Thus, PCs are worked out using a_{ij} weights and the standardised variables measured as the deviations of the X_j 's from the means and subsequently divided by the standard deviations, i.e., $Z_i = x_j/s_{xj}$.

Where, $x_j = X_j - \bar{X}_j$ and $s_{xj} = \text{Standard deviation}$

These variables have the following properties:

Its j^{th} mean and variance are given by $\bar{P}_j = 0$ and $S_{P_j}^2 = \lambda_j$

Coefficient (a_{ij})

The a_{ij} coefficient values have been used to compute the principal component scores for each case. The components scores are computed by multiplying variable standardize values by coefficients. For principal component extractions, these coefficients give exact component scores. Since, it shows the relative importance of variables in the principal components.

Furthermore, it follows the following property: $\sum_{j=1}^m a_{ij}^2 = 1$

Loading ($r_{X_i P_j}$)

The loading for each variable on the component represents the correlation between the item and component. This is done by looking for a common thread among the variables that have large loadings for a particular component. These correlations help to formulate an interpretation of the components. This can be shown as:

$$r_{X_i P_j} = a_{ij} \sqrt{\lambda_j}$$

Variance (σ_{ii})

The variance measures the spread of the distribution of a variable around the mean. The value of variance in the observed variables accounted for by each component is estimated by eigen value or latent root. The variance is large when observations are widely spread about their mean, and small if observations are all close to the mean. The variance of j^{th} component expressed as $\text{Var}(P_j) = \lambda_j$ and percentage variation accounted by $P_j = (\lambda_j / m) * 100$.

The sum of the latent roots of all the PCs is equal to the number of X's

$$\sum_{j=1}^m \lambda_j = m$$

The distribution of variances of the components among the observed variables can be measured by the following equation:

$$\text{Var}(X_i) = \sum_{j=1}^m a_{ij}^2 \text{Var}(P_j) = \sum_{j=1}^m a_{ij}^2 \lambda_j = 1$$

Communality (h_i^2)

The communality indicates the total amount of variance in each variable that is accounted by the common factors. Hence, the communality is the proportion of the variance of a variable that can be explained by the common factors of that variable. In the principal component solution, all initial communalities are one. Since it estimates the extracted components how much cumulative variances retained by that variable. If the portion of the variance of the i^{th} variable contributed by the k common factors out of m factors is shown as

follows: $h_i^2 = \sum_{j=1}^k a_{ij}^2 \lambda_j$

Kaiser's Rule

Any principal component with eigen value less than one contains less information than one of the original variables and so it is not worth retaining. This decision rule has been suggested by Guttman and adopted by Kaiser. This rule is called Kaiser's rules and retains only those principal components whose eigen values are greater than or equal to one. Cattell has also suggested that Kaiser's criterion is most reliable when the number of variables are between twenty and fifty (Koutsoyiannis, 1978). This rule has been applied to determine

the number of principal components to be retained and explained, in the present study.

3.3.4 Estimation of the Principal Component Model

Through the principal component approach, the major potential indicators of agricultural development were identified in each state. The contribution of the potential indicators was assessed by employing the Principal Component Regression (PCR). Because, least squares parameter estimation and its associated regression methodology is highly susceptible to the effects of multicollinearities. Numerical values of coefficient estimates, variances and covariances of the estimators, test statistics, and predicted responses can all be adversely affected by strong multicollinearities among the explanatory variables (Gunst and Mason, 1980). The estimation of ordinary least square (OLS) model resulted as high standard error due to high multicollinearities presence among the explanatory variables.

It has been examined that the data on the agricultural development indicators were showing strong multicollinearities and affecting the estimates of explanatory variables. Therefore, PCR model was used to estimate the contribution of the explanatory variables. The PCR model is the resolving technique of multicollinearities. Gunst and Mason (1980), Draper and Smith (1981) and Chatterjee and Price (1977) showed by the PCR that the loss of information as a result of artificial orthogonalisation can often lead to better estimation of the parameters of the original regression model. It is so even in cases in which no economic meaning can be given to the artificial variable.

To apply the PCR model, the previous method followed to identify the PCs which are the linear combination of the standardized original variables. In the following para, it has been given in details, how to derive and transform the estimates incorporate with the linear formulation of the estimation.

In the linear formulation, the estimation model may be put as

$$Y = X\beta + u \quad (19)$$

where, Y is an $(n \times 1)$ vector of observations on the response variable, X is an $(n \times m)$ matrix of n observations on the m regressors or explanatory variables, β is the $(m \times 1)$ vector of parameters to be estimated and u is a $(n \times 1)$ vector of stochastic disturbances (with distribution $0, \sigma^2 I$).

It is known that the OLS estimator is

$$\hat{\beta} = (X'X)^{-1} X'Y \quad (20)$$

These have BLUE (best linear unbiased estimator) properties. The performance of the OLS estimator is poor if the regressor variables are not uncorrelated.

The regression model of Equation (19) can be restated in terms of the PCs as follows:

$$\begin{aligned} Y &= X\beta + u \\ &= PA'\beta + u \\ &= P\gamma + u \end{aligned} \quad (21)$$

Where, $\gamma = A'\beta$

$$P = XA$$

P is a $(n \times m)$ PCs matrix and A is an $(m \times m)$ orthogonal matrix.

If all the principal components retained, it forms Equation (21) that $Y=P\gamma + u$ and the application of OLS would give identical estimates with those given by the direct application of OLS to model (19) by using the original data of explanatory variables.

But, a principal component estimator β^* of β is one obtained by deleting one or more columns from the transformation matrix A. The total amount of variation accounted for by each of the principal components is equal to the corresponding eigen value. Kaiser's Rule ($\lambda \geq 1$) decides the number of components for consideration as follows:

If out of the eigen roots $\lambda_1, \lambda_2, \dots, \lambda_m$ the first k roots $\lambda_1, \lambda_2, \dots, \lambda_k$ ($k < m$) are both sufficiently large and sufficiently different then, in the transformation matrix A, the columns corresponding to $\lambda_1, \lambda_2, \dots, \lambda_k$ are retained and the remaining $m-k$ columns are replaced by zero columns.

In this study considered the identified potential indicators as explanatory variables for each state, those varied from state to state and PCs were selected by using Kaiser's rule, which has been defined earlier. The response variable has been considered as the agricultural development indices of the states.

Assume that with the above procedure once retains k (where $k < m$) out of all the principal components. Having decided upon the number of components (k) to be retained for the purpose of the analysis the OLS model (19) will be replaced by

$$Y=P\gamma+\varepsilon \quad (22)$$

$$P=ZA, \quad A=(a_1, a_2, \dots, a_k) \quad (23)$$

Where, P is the transformed matrix of n observations of the k principal components, which is known as Principal Component Score and Z is the $(n \times m)$ matrix of standardized explanatory variables, γ is $(k \times 1)$ vector of parameters and ϵ is $(n \times 1)$ vector of random disturbances.

The application of OLS method to Equation (22) gives γ^* as an estimate of γ . The estimated model in terms of the principal component thus is,

$$Y = P \gamma^* \quad (24)$$

So that γ^* becomes

$$\gamma^* = (P'P)^{-1} P'Y \quad (25)$$

$$\text{and Var}(\gamma^*) = \sigma^2 (P'P)^{-1} \quad (26)$$

Effecting the transformation (23), the estimated model in terms of the standardized variable is

$$Y = Z \beta^* \quad (27)$$

$$\text{and } \beta^* = A \gamma^* \quad (28)$$

Where, β^* is the principal component estimator of β as standardized form. The Variances of the estimates of β , based on the use of PCs, have been obtained by the solving of following equation.

$$V(\beta^*) = A[V(\gamma^*)]A' \quad (29)$$

The principal component estimator β^* is such that the variance of an element of β^* must be smaller than the variance of the corresponding element of OLS estimator $\hat{\beta}$.

3.3.5 Assessing Contribution of the Indicators of Agricultural Development

Finally, in order to examine the overall contribution of agricultural development indicators across the states, the Cobb-Douglas type of function has been used with intercept dummy variables that can be obtained through pooled regression (Gujarati, 1995) by combining time and cross-sectional observations of the different states data. By this way, states as the dummy variables could capture the region effect in the model, which is able to lead to good precision of the estimates rather than linear relationship. Assuming a Cobb-Douglas function as given below:

$$\ln Y_{it} = \alpha_i + \sum_{k=1}^m \beta_k \ln X_{kit} + \sum_{i=1}^{N-1} \gamma_i D_i + u_{it} \quad (30)$$

Where $i = \text{States} = 1, 2, \dots, N = 18$

$t = \text{Periods} = 1, 2, \dots, T = 1971-72 \text{ to } 1995-96$

$X = \text{indicator of agricultural development}$

$k = \text{number of indicators} = 1, 2, \dots, m = 22$

$D_i = 1 \text{ if } i^{\text{th}} \text{ state and zero otherwise}$

$Y_{it} = \text{the agricultural development index of the } i^{\text{th}} \text{ state in period } t.$

$X_{kit} = \text{the level of } k^{\text{th}} \text{ indicator of agricultural development for the } i^{\text{th}} \text{ state in period } t.$

$\alpha_i = \text{intercept term for } i^{\text{th}} \text{ State as constant term (base).}$

$\beta_k = \text{the actual response of the agricultural development to the } k^{\text{th}} \text{ indicator.}$

$\gamma_j = \text{accounts for inter-state differential effect in agricultural development of } i^{\text{th}} \text{ State.}$

$U_{it} = \text{the disturbance term by the } i^{\text{th}} \text{ state in period } t.$

3.4 Policy Implications

The findings of the study would be used to formulate policies to minimize the inter-state disparities and to promote agricultural development in country. The proper policy implications for the agricultural development would be guided by the equity, efficiency, productivity and sustainability of agriculture, which are the fundamental factors of balanced agricultural development.

CHAPTER IV

RESULTS AND DISCUSSIONS

India has made impressive strides in agricultural development during the last five decades, though there exist inter-state disparities in agricultural development. India is a vast developing country with marked diversities in agro-climatic conditions, resource endowments and population density. These resulted in uneven economic and agricultural development. However, the degree and extent of disparities vary from state to state and from period to period. In spite of disparities, there is ample opportunity to increase the agricultural productivity by dissemination of modern technology to less developed states.

Keeping in view the predominant position of the agricultural sector, the balanced agricultural development of the states is needed which is also an important objective of development planning in India. Balanced agricultural development of the states is a relative term that depends on various factors, these are associated with natural and physical resources. So, an attempt has been made to quantitatively measure the spatio-temporal disparities, which can furnish the level of disparities in agricultural development across the states. The results of the study are discussed in this chapter under the four main heads:

- 4.1 Spatio-temporal level of agricultural development disparities;
- 4.2 Potential factors of agricultural development;
- 4.3 Assessment of the contribution of the potential factors in agricultural development and
- 4.4 Emerging policy issues for balanced agricultural development.

4.1 Spatio-temporal Level of Agricultural Development Disparities

Though the main objective of national policy is balanced development of the regions or states but still after five decades of development planning presents a picture of uneven regional development. A number of studies on regional development in India have shown that the regional disparities in India have increased over the plan period – irrespective of whether they are measured in per capita state domestic product or growth rates of net state domestic product. Various studies have found regional disparities to be diverging with the process of economic growth, nevertheless not a single study analyzed agricultural development in depth. In view of this, the study was taken up to measure the spatio-temporal disparities by constructing the composite agricultural development index (CADI) of the 17 major states and all India by assigning different weights to the indicators of agricultural development.

4.1.1 Weightage of the Agricultural Development Indicators

Any index of development based on multivariate data has its own limitations. A major limitation arises from the assumptions made about the indicators themselves and their weightage in the aggregate index. It might be believed that any inter-state comparison of levels of development would be more efficient when the variability in the composite index is stabilized. Therefore, the study adopts the weighting method for constructing the CADI.

Table 4.1 shows the weightage of agricultural development indicators at different time periods. The weightage is more or less uniform though every time periods it had changed their values according to the variability of the scaled values in that period. It reveals that the highest weightage is for rural literacy (0.0516) and foodgrain productivity (0.0504) in 1971-72, whereas primary agricultural cooperative society (0.0516), regulated market (0.0510), expenditure on research and agricultural education (0.0505), and rural literacy (0.0502) in 1975-76; foodgrain productivity (0.0533), fertilizer consumption (0.0522), and regulated market (0.0519) in 1980-81; regulated market (0.0534), fertilizer consumption (0.0524), foodgrain productivity (0.0524), primary agricultural cooperative society (0.0523), rural literacy (0.0509), and per capita AgNSDP (0.0504) in 1985-86; regulated market (0.0546), rural literacy (0.0524), food grain productivity (0.0517), and per capita AgNSDP (0.0501) in 1990-91 and per capita AgNSDP (0.0523), regulated market (0.0510), and share of AgNSDP (0.0501) receive more weightage in 1995-96 respectively.

The indicators of rural electrification, i.e., the percentage of villages electrified and electricity consumption in agriculture got the lowest score over the time periods, whereas the regulated market and rural literacy got more weightage than other indicators. However, the weightage of all the indicators marginally increased or decreased over the time periods. It clearly reflects that priorities have shifted with the change of time span.

Table 4.1 Weightage for the agricultural development indicators at different time periods

Agricultural Development Indicators	Weightage					
	1971-72	1975-76	1980-81	1985-86	1990-91	1995-96
Cropping Intensity	0.0455	0.0436	0.0411	0.0388	0.0400	0.0423
Irrigation Intensity	0.0489	0.0433	0.0421	0.0445	0.0446	0.0460
Net Sown Area	0.0445	0.0450	0.0471	0.0473	0.0473	0.0456
Net Irrigated Area	0.0462	0.0446	0.0443	0.0469	0.0466	0.0444
Area under HYVs	0.0404	0.0461	0.0442	0.0455	0.0476	0.0477
Fertilizer Consumption	0.0441	0.0489	0.0522	0.0524	0.0478	0.0439
Foodgrain Productivity	0.0504	0.0490	0.0533	0.0524	0.0517	0.0490
Agricultural Workers	0.0406	0.0411	0.0423	0.0429	0.0444	0.0431
Livestock Density	0.0432	0.0423	0.0430	0.0442	0.0489	0.0494
Pumpset	0.0481	0.0493	0.0492	0.0442	0.0406	0.0428
Tractor	0.0488	0.0483	0.0475	0.0421	0.0431	0.0448
Regulated Market	0.0489	0.0510	0.0519	0.0534	0.0546	0.0510
Electrified Villages	0.0387	0.0369	0.0366	0.0339	0.0347	0.0399
Electricity Consumption in Agriculture	0.0404	0.0388	0.0343	0.0383	0.0374	0.0337
Density of Rural Roads	0.0477	0.0446	0.0457	0.0462	0.0451	0.0404
Primary Agricultural Cooperative Society	0.0477	0.0516	0.0490	0.0523	0.0482	0.0463
Rural Literacy	0.0516	0.0502	0.0497	0.0509	0.0524	0.0497
Net Value of Agricultural Production	0.0413	0.0432	0.0464	0.0458	0.0453	0.0441
Expenditure on Agricultural Research and Education	0.0467	0.0505	0.0488	0.0468	0.0464	0.0481
Expenditure on Extension	0.0423	0.0440	0.0427	0.0396	0.0396	0.0456
Share of AgNSDP	0.0475	0.0399	0.0417	0.0414	0.0439	0.0501
Per Capita AgNSDP	0.0464	0.0475	0.0470	0.0504	0.0501	0.0523

4.1.2 Dimension of Disparity Level of Agricultural Development

Agriculture provides sustenance, nutrition and occupation to large proportion of the population of India. It provides raw material to industries, and sustains the very fabric of the city life. Hence, agriculture is and shall continue to be the most important basis of Indian economy. However, there are inter-state variations in agricultural development, which is influenced by a number of factors. Therefore, the CADIs have been constructed with the help of weighting method for 17 major states and all India for the periods 1971-72 to 1995-96 (Appendix 1). However, the indices have been reported at five years interval viewing the comparative situation of agricultural development of the states over the time periods and across the states.

The CADIs of the major states and all India are presented in the Table 4.2, that clearly portrays the spatio-temporal disparities across the states. The CADIs of most of the states showed an increasing trend except in two states Assam and Kerala where the indices showed the declining trend. However in most of the states the process of development was not smooth during the study period. Only Andhra Pradesh, Maharashtra, Uttar Pradesh, West Bengal and all India had positive trend of agricultural development throughout the period. In Assam, Gujarat, Madhya Pradesh and Orissa the CADIs declined and in other states increased considerably during the period 1971-72 to 1975-76. But in the next period (1980-81), Gujarat and Orissa improved their situation though Assam and Madhya Pradesh had gone down again. In comparison to previous periods, Himachal Pradesh had sharply declined whereas Kerala and Punjab marginally declined in 1985-86 and Himachal Pradesh and Punjab revived their

position again in the next period 1990-91 but Kerala continued declining trend up to 1995-96. Table 4.2 also reveals that Bihar and Rajasthan had shown declining trend in 1990-91 that continued till 1995-96 and Haryana and Punjab also declined their indices of agricultural development after 1990-91.

Table 4.2 Composite agricultural development indices and coefficient of variations of the indices of the major states and all India at different time periods

States	Composite Agricultural Development Index (%)					
	1971-72	1975-76	1980-81	1985-86	1990-91	1995-96
Andhra Pradesh	31.17	31.30	32.84	32.84	35.98	37.24
Assam	27.26	25.77	25.55	26.03	25.38	24.03
Bihar	34.01	34.40	36.05	39.14	36.35	36.19
Gujarat	26.90	23.79	29.73	27.73	29.85	30.45
Haryana	53.99	55.04	56.10	56.73	59.48	58.18
Himachal Pradesh	39.47	41.75	39.27	35.91	40.56	36.93
Jammu and Kashmir	28.58	29.42	32.03	36.20	35.17	36.74
Karnataka	23.32	25.88	25.50	25.81	28.22	31.53
Kerala	42.66	39.95	40.97	39.77	36.00	36.28
Madhya Pradesh	13.15	12.78	11.58	13.85	16.39	20.89
Maharashtra	15.32	22.91	25.94	27.14	28.88	29.24
Orissa	21.05	19.80	22.05	22.93	22.20	21.81
Punjab	67.30	73.36	74.85	74.01	75.19	73.59
Rajasthan	16.70	18.27	22.52	20.11	19.51	18.73
Tamil Nadu	46.86	46.74	47.88	47.97	46.86	52.13
Uttar Pradesh	31.22	31.49	33.46	35.88	38.31	40.01
West Bengal	31.03	32.23	35.90	38.94	42.22	43.32
All India	26.56	29.05	31.13	31.16	32.21	33.07
Coefficient of variations	43.36	43.82	41.10	39.88	39.20	37.43

It was identified that the only Assam state chronologically had declined the indices in comparison to other states. The main reason for the extreme position of Assam is prevalence of lower level and growth of considered indicators of agricultural development. This is supported by the findings of Datta and Jain (1994), who attribute it to its inadequate infrastructure, the peculiar problem in the sphere of agriculture, inadequate credit and storage facilities. At the other extreme, Punjab is always showing the upward movement due to its basic institutional and economic infrastructure along with the outlook of the farmers. Though, it is difficult to identify specific reasons for disparities in agricultural development because of its biological nature and dependency on agro-climatic factors. Besides, in subsequent paras, imbalances of indicators have been explained, which are causal factors of disparities across the states.

If CADIs of all India is compared with all other major states during the study period (1971-72 to 1995-96), there emerged very typical pictures, which have been depicted in Figures 4.1 to 4.4. Figure 4.1 shows that all-northern region states i.e., Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab and Uttar Pradesh were always above all India in agricultural development from the very beginning 1970-71. The southern region states i.e., Andhra Pradesh, Kerala, and Tamil Nadu were also above all India but for Karnataka state was in below (Figure 4.2). While two eastern region states, Bihar and West Bengal were above and Assam and Orissa were below all India (Figure 4.3). Besides, the western region states i.e., Gujarat, Madhya Pradesh, Maharashtra and Rajasthan were always far behind all India since 1971-72 (Figure 4.4).

Figure 4.1 Trends in composite indices
northern states and all India

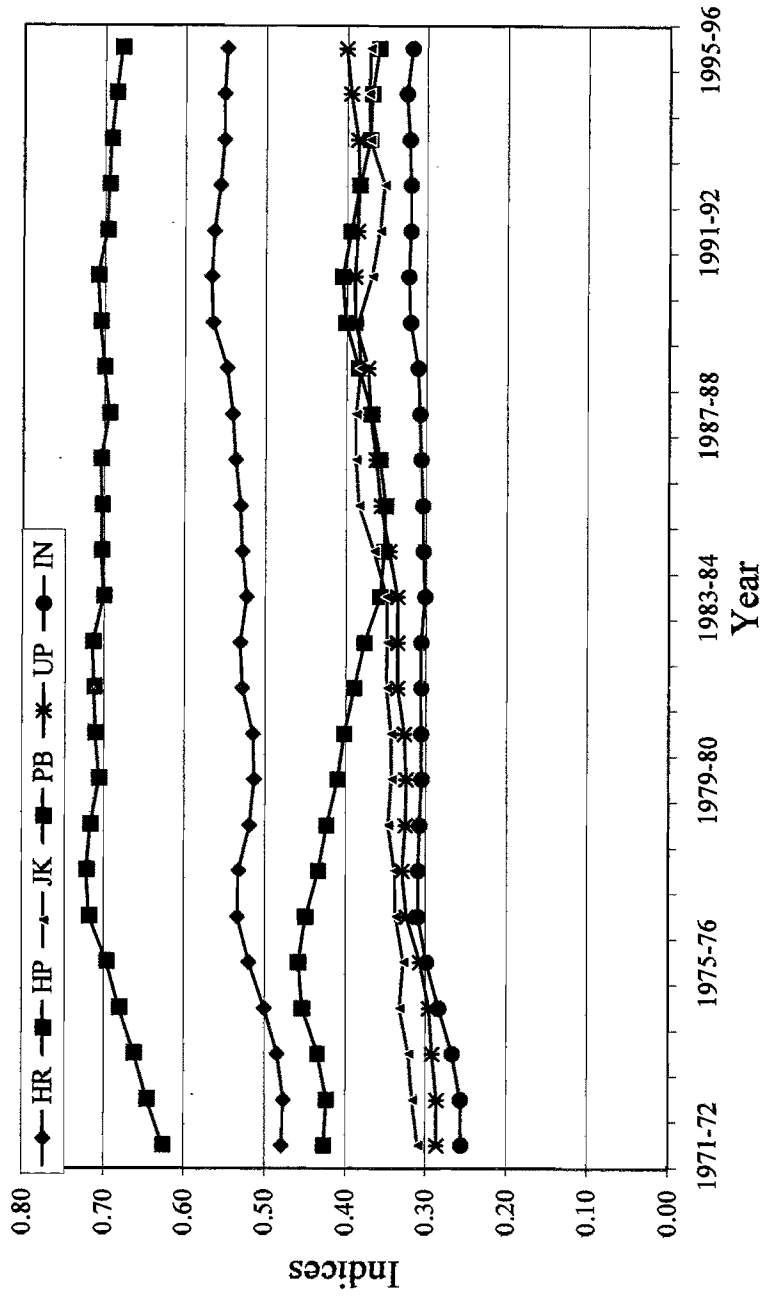


Figure 4.2 Trends in composite 48 southern states and all India

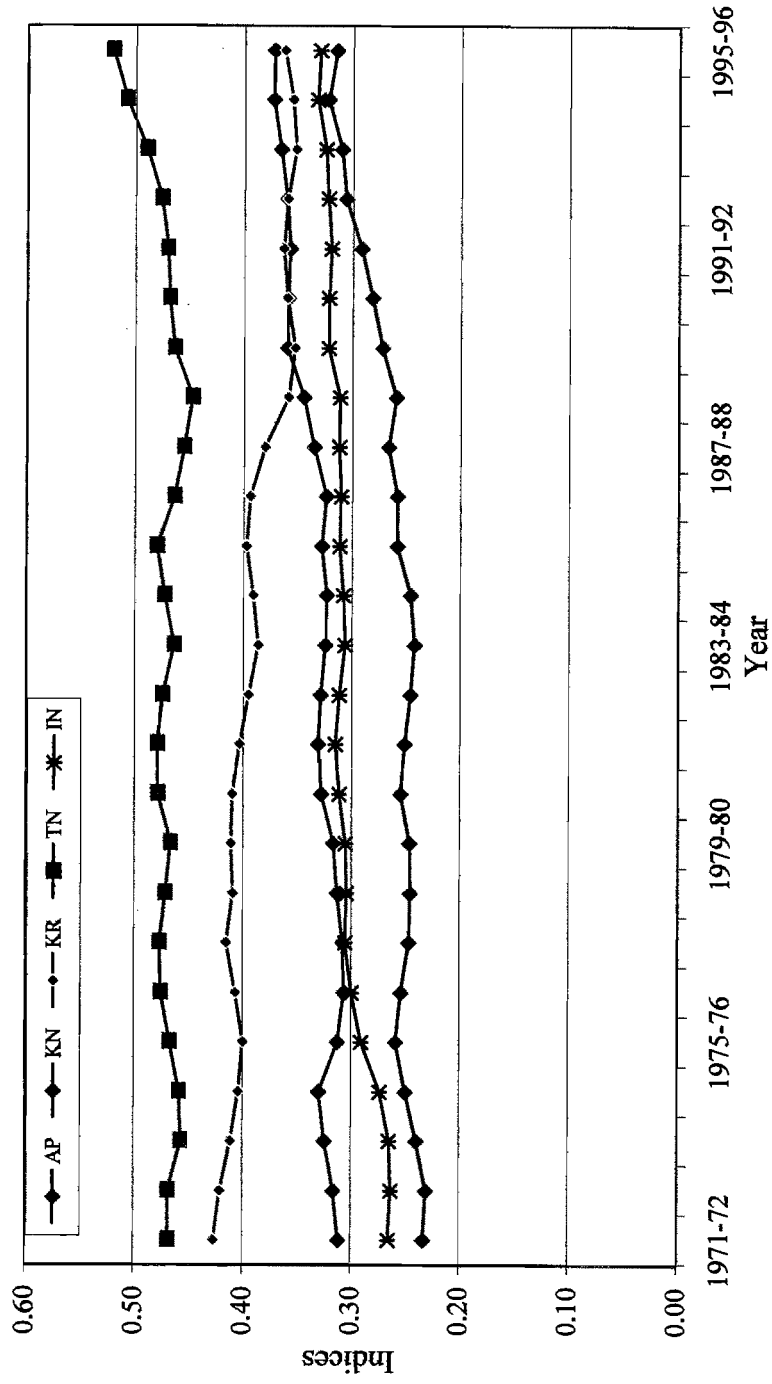


Figure 4.3 Trends of composite agricultural development indices eastern states and all India

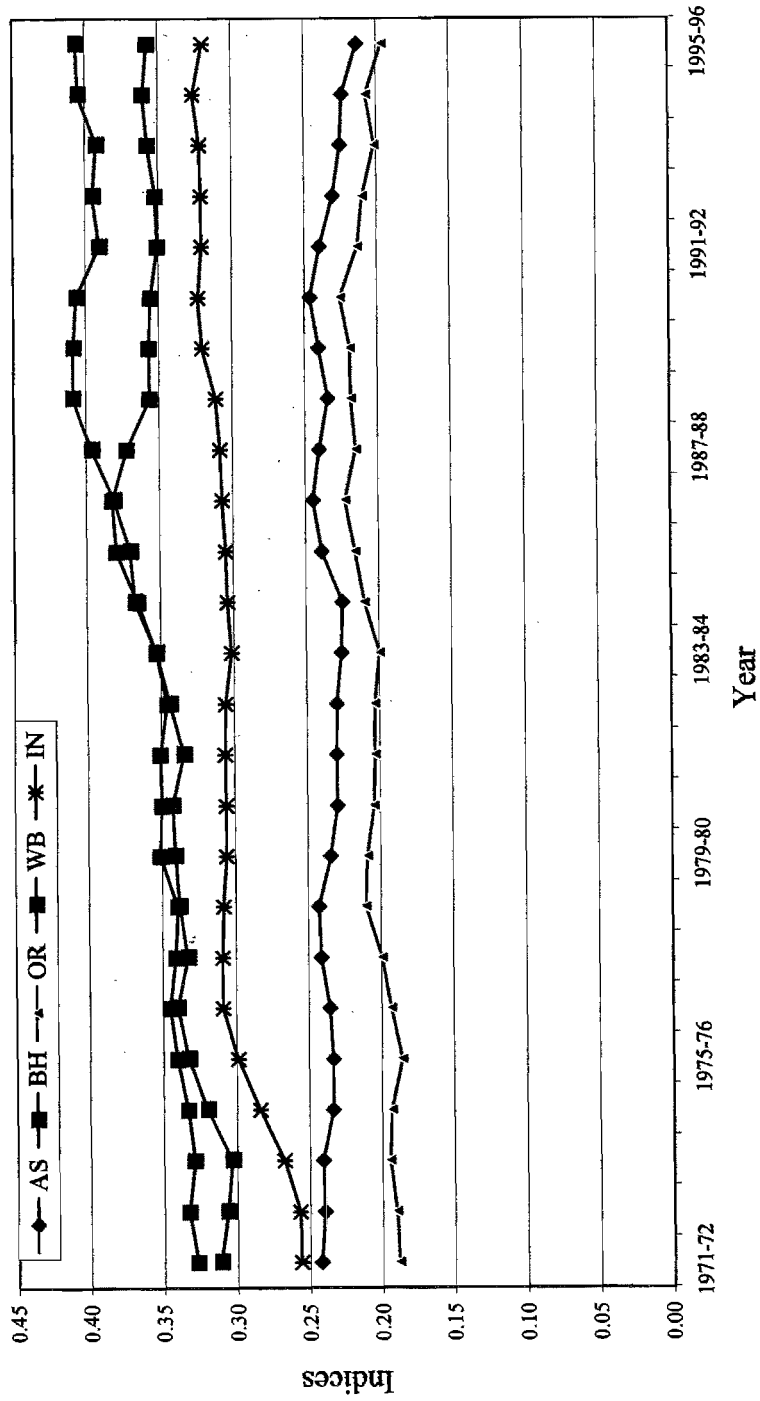
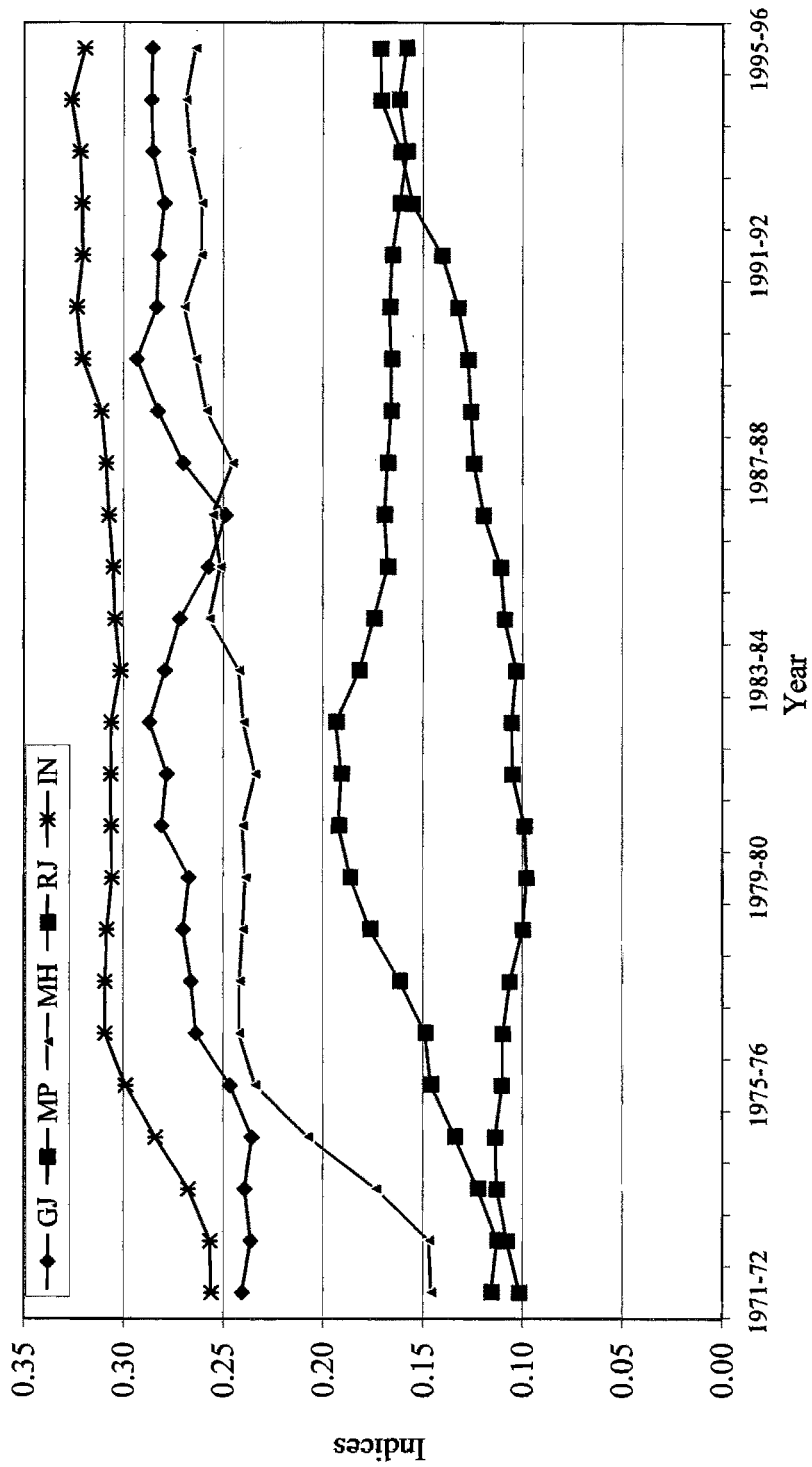


Figure 4.4 Trends of composite agricultural development indices of western states and all India

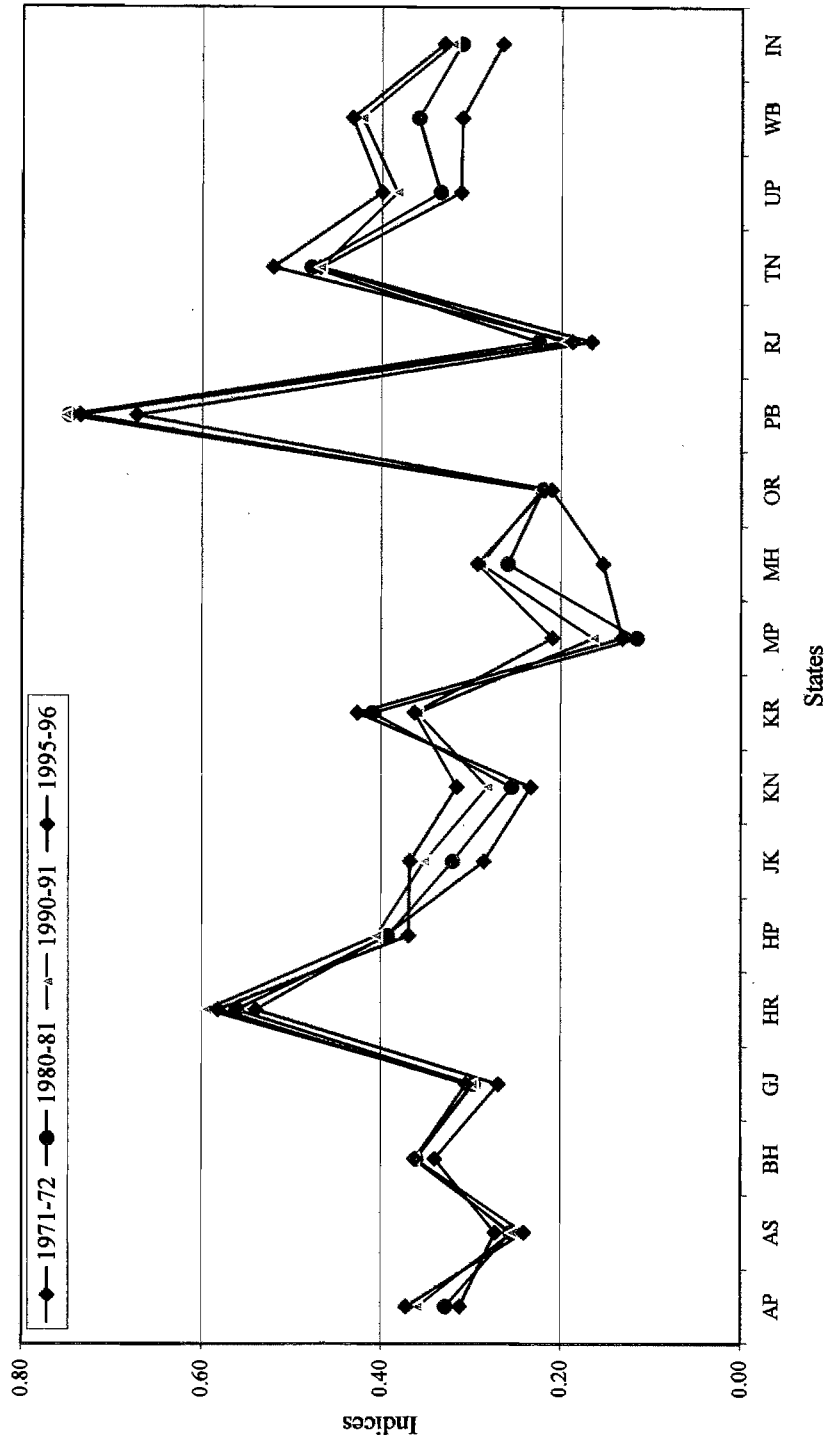


It is inferred from these figures that northern and southern states are developed, eastern states are moderately developed and western states are less developed in comparison to all India in agricultural development.

On the other hand, temporal situation was very discriminating, where large variations existed in CADIs across the states. The highest index of Punjab was 67.30 whereas the lowest was 13.15 of Madhya Pradesh and the coefficient of variation of the indices was 43.36 per cent in 1971-72. Punjab always had the highest indices and Madhya Pradesh had the lowest indices except the period of 1995-96, where Rajasthan was having the lowest index (Table 4.2). The CADIs among the states and over the different time interval have been shown in the Figure 4.5, which depicted the variations of indices and disparity level of agricultural development across the states. The declining coefficients of variations over the time reveal narrowing down the regional disparities. The coefficient of variation declined from 43.36 per cent in 1971-72 to 37.43 percent in 1995-96 indicating a convergent trend in the inter-state levels of agricultural development

Thus, it may be inferred that the strategy of agricultural development has played a positive role in reducing the incidence of inter-state disparities during the period under study.

Figure 4.5 Agricultural development disparities across the states at different time period



4.1.3 Agricultural Development Stages of the States and All India

Ranking is the simplest method to measure the relative position of the states but is not used for classifying the states according to their level of development. To classify the states, the study employed Beta distribution assuming that mean of the states indices (\bar{y}) has a Beta distribution in the range zero to one. The Beta distribution is used for graduating the state indices because of their skewness and its finite range. However, this study used both the techniques to examine status of the states and all India.

Based on the CADIs the states were ranked which helps to assess relative position of the states. It may happen that absolute value of state indices has gone up but its relative position may change or may not.

Table 4.3 shows the rank of the 17 major states and all India at different time periods. Punjab, Haryana, and Tamil Nadu hold first, second and third position respectively during the study period. Over the period 1971-72 to 1995-96, West Bengal, Uttar Pradesh, Andhra Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, and Maharashtra showed convergent trend in respect of both rank and CADIs. Assam, Bihar, Gujarat, Himachal Pradesh, Kerala, Orissa, and Rajasthan showed divergent trend in respect of rank, whereas divergent trend in respect of CADIs was observed only in Assam, Himachal Pradesh and Kerala. All India showed converging trend in CADIs and held the same ranking position at 11 except in the initial year 1971-72, when it ranked 13. It was observed that the states changed their rank due to change in their absolute indices during the study periods.

Beta distribution is used to know the status of development of the states. The states were classified in four categories, namely developed, moderately developed, developing and less developed states according to their z^{th} fractile values. Table 4.4 shows the Beta distribution estimated parameters and fractal values of classification of the states.

Table 4.3 Ranking of the major states and all India at different time periods

State	Ranking					
	1971-72	1975-76	1980-81	1985-86	1990-91	1995-96
Andhra Pradesh	8	9	9	10	9	6
Assam	11	13	14	14	15	15
Bihar	6	6	6	5	7	10
Gujarat	12	14	12	12	12	13
Haryana	2	2	2	2	2	2
Himachal Pradesh	5	4	5	8	5	7
Jammu and Kashmir	10	10	10	7	10	8
Karnataka	14	12	15	15	14	12
Kerala	4	5	4	4	8	9
Madhya Pradesh	18	18	18	18	18	17
Maharashtra	17	15	13	13	13	14
Orissa	15	16	17	16	16	16
Punjab	1	1	1	1	1	1
Rajasthan	16	17	16	17	17	18
Tamil Nadu	3	3	3	3	3	3
Uttar Pradesh	7	8	8	9	6	5
West Bengal	9	7	7	6	4	4
All India	13	11	11	11	11	11

According to z^{th} fractile values, the states were grouped in four categories at different time periods, which are shown in Table 4.5. Punjab, Haryana and Tamil Nadu belonged to the developed group, however, in 1990-91 Tamil Nadu had gone down in moderately developed group due to marginal difference of z^{th} value and index value. Madhya Pradesh, Orissa, and Rajasthan remained in the less developed group, while Gujarat, Karnataka and all India

were in developing group in all the grouping periods. Maharashtra belonged to developing group except the initial period (1971-72). Andhra Pradesh and Uttar Pradesh belonged to moderately developed group in starting period but marginally these states had gone down in developing group from the next period (1975-76). However, Uttar Pradesh came up again in moderately developed group in the period 1985-86 and Andhra Pradesh in 1990-91 and onwards. On the other hand Jammu & Kashmir and Assam moved in opposite direction of development.

Table 4.4 Estimated parameters of Beta distribution and fractal values of classification at different time periods

Year	Estimated Parameters		Degree of Freedom		Fractal value		
	a	b	n ₁	n ₂	z ₁	z ₂	z ₃
1971-72	3.2948	6.9921	6.5897	13.9842	0.2156	0.3082	0.4469
1975-76	3.1597	6.4165	6.3195	12.8330	0.2207	0.3177	0.4613
1980-81	3.5230	6.6502	7.0459	13.3004	0.2399	0.3360	0.4707
1985-86	3.7287	6.8883	7.4575	13.7767	0.2467	0.3416	0.4722
1990-91	3.8009	6.7451	7.6017	13.4901	0.2552	0.3513	0.4810
1995-96	4.1526	7.1662	8.3053	14.3323	0.2653	0.3588	0.4818

Jammu & Kashmir had come up from developing group to moderately developed group and Assam had gone down from developing group to less developed group during the period 1971-72 to 1995-96. Since, several states changed their ranking but stages of agricultural development remained same all over the time periods. It is concluded that the agricultural development took place in all the states, but it was unevenly distributed across the states all through the time periods.

Table 4.5. Agricultural development stages of the major states and all India at different time periods

Year	Stages of Agricultural Development		
	Highly developed	Developed	Developing
1971-72	Punjab, Haryana and Tamil Nadu	Kerala, Himachal Pradesh, Bihar, Uttar Pradesh, Andhara Pradesh, and West Bengal	Jammu & Kashmir, Assam, Gujarat, All India, and Karnataka,
1975-76	Punjab, Haryana and Tamil Nadu	Himachal Pradesh, Kerala, Bihar and West Bengal	Uttar Pradesh, Andhara Pradesh, Jammu & Kashmir, All India, Karnataka, Assam, Gujarat and Maharashtra
1980-81	Punjab, Haryana and Tamil Nadu	Kerala, Himachal Pradesh, Bihar and West Bengal	Uttar Pradesh, Andhara Pradesh, Jammu & Kashmir, All India, Gujarat, Maharashtra, Assam and Karnataka
1985-86	Punjab, Haryana and Tamil Nadu	Kerala, Bihar, West Bengal, Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh	Andhara Pradesh, All India, Gujarat, Maharashtra, Assam and Karnataka
1990-91	Punjab and Haryana	Tamil Nadu, West Bengal, Himachal Pradesh, Uttar Pradesh, Bihar, Kerala, Andhara Pradesh and Jammu & Kashmir	All India, Gujarat, Maharashtra and Karnataka
1995-96	Punjab, Haryana and Tamil Nadu	West Bengal, Uttar Pradesh, Andhara Pradesh, Himachal Pradesh, Jammu & Kashmir, Kerala and Bihar	All India, Karnataka, Gujarat and Maharashtra
			Assam, Orissa, Rajasthan, and Madhya Pradesh
			Assam, Madhya Pradesh, Orissa and Rajasthan

4.1.5 Imbalances of Agricultural Development Indicators

It is observed from the previous results and discussions that there were sharp disparities prevailed across the states from the beginning (1971-72). It is quite difficult to identify the specific factors, which are responsible for the disparities of agricultural development. Moreover, the factors considered in the analysis are not exhaustive, because development is a result of interlinkage effect of many factors. However, the measure of the coefficient of imbalances for indicators across the states and over the years within the state gives a clue for disparities of agricultural development.

Table 4.6 shows the coefficient of imbalances for agricultural development indicators which is coefficient of variations of the indicators across the states at the beginning and ending period of the study. Out of the total 22 indicators, only 7 indicators showed the divergent trend, while the remaining 15 showed converging trend. The degree of divergences varied from 0.42 to 24.53, while that for convergent varied from -0.26 to -560.34 among the indicators. The maximum divergent trend was shown by livestock density, followed by cropping intensity and agricultural workers, while the maximum convergent trend was shown by electrified villages, followed by area under high yielding varieties, pumpset, electricity consumption in agriculture, expenditure on agricultural research and education, and fertilizer consumption and so on.

The major indicators, which showed maximum degree of imbalances were tractor, regulated markets, expenditure on extension, expenditure on agricultural research and education, pumpset, primary agricultural cooperative

society, electricity consumption in agriculture, density of rural roads, livestock density and fertilizer consumption in 1995-96. It was found that electrified villages had shown the least degree of variations (10.38 per cent) and it was followed by the cropping intensity (16.23 per cent), and irrigation intensity (17.83 per cent) in the year 1995-96.

Table 4.6 Coefficient of imbalances for agricultural development indicators across the major states and all India during 1971-72 and 1995-96

Agricultural Development Indicators	Coefficient of imbalance (per cent)		Relative change (per cent)
	1971-72	1995-96	
Cropping Intensity	12.30	16.23	24.23
Irrigation Intensity	22.69	17.83	-27.24
Net Sown Area	35.98	36.13	0.42
Net Irrigated Area	64.97	54.79	-18.57
Area under HYVs	70.52	22.67	-211.02
Fertilizer Consumption	81.90	55.70	-47.05
Foodgrain Productivity	37.87	39.45	4.01
Agricultural Workers	36.20	45.11	19.76
Livestock Density	43.64	57.82	24.53
Pumpset	143.37	81.21	-76.55
Tractor	175.72	163.34	-7.58
Regulated Market	120.78	112.99	-6.89
Electrified Villages	68.53	10.38	-560.34
Electricity Consumption in Agriculture	97.40	63.26	-53.97
Density of Rural Roads	62.54	60.76	-2.93
Primary Agricultural Cooperative Society	77.18	67.34	-14.60
Rural Literacy	38.27	30.64	-24.88
Net Value of Agricultural Production	35.36	35.27	-0.26
Expenditure on Agricultural Research and Education	124.14	82.66	-50.19
Expenditure on Extension	109.94	94.22	-16.69
Share of AgNSDP	18.76	21.54	12.89
Per Capita AgNSDP	34.24	39.86	14.11

The coefficient of imbalance had been found varying from 10.38 in case of electrified villages to 163.34 in the case of tractor in this period. While tractor, pumpset, expenditure on agricultural research and education, regulated markets, expenditure on extension, fertilizer consumption, electricity consumption in agriculture, primary agricultural cooperative society, area under HYVs and electrified villages showed the maximum degree of imbalances in 1971-72. Though, the imbalances had reduced for most of the indicators from 1971-72 to 1995-96, but tractor, regulated markets, expenditure on agricultural research and education, expenditure on extension, pumpset and electricity consumption in agriculture had shown the wide imbalances during both period. The extent of variability in the coefficient of imbalances for some of the indicators in 1995-96 is almost the same as in 1971-72. These indicators were net sown area, foodgrain productivity, net value of agricultural production, and share of AgNSDP. The most interesting finding emerges from Table 4.6 is that the relative imbalance in the percentage change of electrified villages had declined drastically (-560.34 per cent), followed by the area under HYVs and pumpset. The imbalances in these critical inputs directly influence the productivity, growth and ultimately on agricultural development. It is the major obstacle for balanced agricultural development at the state and all India.

On the other side, imbalances of the indicators were subsisted within the state over the time periods that also impinged the smooth agricultural development. Table 4.7 shows details imbalances for agricultural development indicators of the 17 major states and all India over the time period since 1970-71 to 1996-97.

Table 4.7. Coefficient of imbalances for agricultural development indicators of major states and all India during the period 1970-71 to 1996-97

Agricultural Development Indicators	States									
	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu & Kashmir	Karnataka	Kerala	
Cropping Intensity	3.67	5.97	2.28	2.82	6.63	1.35	4.89	3.25	1.80	
Irrigation Intensity	2.51	Constant	5.43	3.67	7.46	4.41	7.01	3.38	22.33	
Net Sown Area	4.02	5.07	5.60	5.63	2.22	5.00	2.91	3.23	6.76	
Net Irrigated Area	12.52	6.47	19.15	24.48	19.15	5.94	5.18	22.76	24.67	
Area under HYVs	39.74	40.24	38.08	28.61	20.54	24.60	27.49	48.86	40.97	
Fertilizer Consumption	58.82	66.61	65.78	48.28	62.69	47.50	51.55	46.73	44.01	
Foodgrain Productivity	26.47	12.60	21.31	23.08	33.78	14.95	11.49	14.62	10.47	
Agricultural Workers	16.52	7.29	19.61	14.96	13.07	7.10	5.04	12.73	3.92	
Livestock Density	5.59	22.70	24.69	10.89	10.95	2.06	22.67	11.14	6.04	
Pumpsets	48.60	58.18	79.97	21.67	57.35	28.63	53.83	41.77	58.67	
Tractor	75.88	5.79	31.57	69.60	71.44	79.29	32.46	60.31	14.75	
Regulated Market	34.22	64.44	49.80	14.60	28.22	61.64	NA*	27.84	16.49	
Electrified Villages	30.90	11.11	47.29	40.90	6.90	40.94	54.34	21.01	0.00	
Electricity Consumption in Agriculture	34.00	61.64	50.51	41.37	12.07	53.91	44.91	77.43	20.44	
Density of Rural Roads	13.59	21.68	20.34	25.46	15.66	12.94	23.66	20.74	14.16	
Primary Agricultural Cooperative Society	49.64	45.55	46.38	9.34	49.55	7.24	96.94	28.95	10.56	
Rural Literacy	16.48	16.87	15.99	18.34	10.90	18.95	24.52	15.22	12.21	
Net Value of Agricultural Production	93.52	80.80	81.54	90.94	89.17	82.20	87.56	95.44	89.02	
Expenditure on Agricultural Research and Education	101.95	78.46	100.39	92.40	93.27	98.22	82.12	99.85	104.38	
Expenditure on Extension	89.22	97.71	67.48	96.87	127.63	106.94	123.50	80.25	60.04	
Share of AgNSDP	20.20	20.96	16.65	36.28	16.91	23.97	17.53	18.54	19.78	
Per Capita AgNSDP	80.61	73.83	64.27	78.21	77.22	65.57	71.99	86.06	81.61	

Note: *NA – Jammu & Kashmir regulated market act yet not passed.

Continued

Table 4.7. Coefficient of imbalances for agricultural development indicators of major states and all India during the period 1970-71 to 1996-97 (continued)

Agricultural Development Indicators	States									
	Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India	
Cropping Intensity	4.11	4.59	8.65	9.07	3.03	1.98	4.31	8.20	3.74	
Irrigation Intensity	0.71	2.86	10.33	7.71	7.55	3.79	8.58	11.72	2.90	
Net Sown Area	18.03	2.54	3.76	1.14	7.03	5.49	0.61	1.92	1.46	
Net Irrigated Area	43.89	21.21	28.71	9.45	23.44	6.53	15.68	13.41	16.81	
Area under HYV's	52.81	46.98	61.21	14.94	41.09	22.76	33.59	39.36	35.13	
Fertilizer Consumption	67.61	58.25	49.48	39.28	70.25	39.39	48.56	59.59	50.40	
Foodgrain Productivity	22.44	25.44	19.47	22.72	23.79	19.78	27.73	23.39	21.97	
Agricultural Workers	10.58	12.32	6.58	3.36	16.30	18.82	10.79	10.40	12.58	
Livestock Density	1.96	7.80	4.55	5.65	7.31	8.25	6.69	28.25	7.39	
Pumpset	61.97	52.22	75.44	32.06	66.62	16.89	60.57	92.48	41.43	
Tractor	86.07	71.15	22.62	64.36	73.71	62.68	69.39	76.07	68.91	
Regulated Market	31.35	28.75	37.32	33.19	32.04	28.32	25.23	57.46	31.83	
Electrified Villages	59.79	32.21	47.70	17.91	11.17	16.52	38.19	50.15	29.52	
Electricity Consumption in Agriculture	80.64	50.65	71.16	20.17	24.74	8.85	27.27	100.38	32.87	
Density of Rural Roads	27.39	27.32	44.92	29.98	22.74	35.82	33.33	8.32	23.37	
Primary Agricultural Cooperative Society	26.85	3.64	9.39	59.20	18.18	6.23	50.95	13.96	30.97	
Rural Literacy	22.12	10.67	13.41	18.89	24.29	13.29	29.13	22.60	16.43	
Net Value of Agricultural Production	86.53	94.99	72.04	89.15	86.45	107.67	88.20	85.51	90.34	
Expenditure on Agricultural Research and Education	98.44	82.89	90.49	87.60	98.57	131.71	86.22	74.53	88.78	
Expenditure on Extension	94.11	99.57	92.63	63.80	90.22	107.96	154.32	74.27	70.20	
Share of AgNSDP	17.92	18.08	24.15	9.28	17.42	24.01	15.53	15.75	14.26	
Per Capita AgNSDP	77.46	83.59	63.92	82.45	75.86	92.93	74.50	77.19	75.97	

It was observed that the foremost maximum imbalances factors were expenditure on agricultural research and education, expenditure on extension, net value of agricultural production, per capita AgNSDP, tractor, and fertilizer consumption and least imbalances factors were cropping intensity, irrigation intensity, net sown area, net irrigated area, agricultural workers, livestock density and rural literacy and others were moderate imbalances in most of the states, though it varied from the state to state.

From the above discussion, it is clear that some of the important factors like electrified villages, the area under HYVs have helped to reduce the inter-state disparities but at the same time some other factors have further widened the disparities. It may be argued that the counter-balance effect of these factors has helped to reduce the inter-state disparities. Besides, there is very steady growth of indicators in some of the states that could be reason of the slow pace of development over the periods in those states.

Since, the wide variations of inter-state disparities in agricultural development emerged from this study at the temporal and spatial level across the states, which have also affected the correlating sectors that are hidden factors of development.

4.2 Potential Factors of Agricultural Development

The technological breakthrough has brought about spectacular changes in the agricultural production which has geared-up the agricultural development in India. Though, it has been visualized that the uneven development took place due to unequal distribution of resources in the country. It is well known that “Green Revolution” packages has changed total scenarios of agriculture in

India. Further, it led to mechanization of agriculture and infrastructural development. These were pushing factors for total agricultural development. In this study, 22 indicators has been taken to measure the inter-state disparities in agricultural development, these represent agriculture, infrastructure and socio-economic factors. Hence, the study applied Principal Component Analysis (PCA) using time series data to identify the potential factors for agricultural development in the states.

4.2.1 An Investigation of Factors Influencing Agricultural Development

The PCA summarizes high dimensional data into a few dimensions. Each dimension is called a principal component and represents a linear combination of the variables. The first principal component accounts for as much variation in the data as possible. Each succeeding principal component accounts for as much of the variation unaccounted for by preceding principal components as possible. The principal components are sorted by descending order of their variances, which are equal to the associated eigen values. Kaiser's rule has been applied to retain components with associated eigen values greater than one. According to this criterion, it was found that eigen values of three principal components were greater than one for all the states except Assam, Bihar, Karnataka and all India, where only two components were greater than one and in case of Tamil Nadu four components were greater than one. Eigen values and accounted variances of each principal component are shown in Table 4.8. Table 4.8 revealed that the first principal component accounted for more than two-third variation of the indicators for all states except Kerala, which accounted for 60 per cent variance of the indicators. The second principal

component captured maximum variance of 17 per cent for Himachal Pradesh, and minimum of 5.10 per cent for All India. The third principal component accounted for maximum and minimum variances for Tamil Nadu (8.40 per cent) and all India (3.4 per cent). The three components together captured about 90 per cent of variance in various factors of development for all the states and all India.

Table 4.8 Eigen values, variances and cumulative values of the first three principal components of the major states and all India

States	P ₁		P ₂		P ₃		Total	
	Eigen Value	Variances (%)	Eigen Value	Variances (%)	Eigen Value	Variances (%)	Eigen Value	Variances (%)
Andhra Pradesh	15.88	72.20	2.63	12.00	1.33	6.00	19.84	90.20
Assam	17.26	78.50	2.33	10.60	0.82	3.70	20.42	92.80
Bihar	17.07	77.60	2.02	9.20	0.88	4.00	19.97	90.80
Gujarat	16.25	73.90	2.53	11.50	1.33	6.00	20.11	91.40
Haryana	16.55	75.20	1.89	8.60	1.66	7.50	20.09	91.30
Himachal Pradesh	15.16	68.90	3.75	17.00	1.13	5.10	20.04	91.10
Jammu and Kashmir	16.09	76.60	1.78	8.50	1.14	5.40	19.00	90.50
Karnataka	17.86	81.20	1.48	6.70	0.99	4.50	20.33	92.40
Kerala	13.30	60.40	3.43	15.60	1.59	7.20	18.32	83.30
Madhya Pradesh	16.90	76.80	1.62	7.30	1.15	5.20	19.66	89.30
Maharashtra	16.23	73.80	3.00	13.60	1.32	6.00	20.54	93.40
Orissa	15.61	70.90	2.81	12.80	1.35	6.10	19.76	89.80
Punjab	17.05	77.50	2.71	12.30	1.02	4.70	20.78	94.50
Rajashtan	15.61	71.00	2.72	12.40	1.34	6.10	19.67	89.40
Tamil nadu*	14.50	65.90	3.16	14.30	1.85	8.40	19.51	88.70
Uttar Pradesh	17.98	81.70	1.86	8.50	1.08	4.90	20.92	95.10
West Bengal	16.63	75.60	2.81	12.80	1.08	4.90	20.52	93.30
All India	19.74	89.70	1.12	5.10	0.76	3.40	21.62	98.30

Note: *There was one more principal component's eigen value greater than one (1.19) that accounted variance 5.40.

P₁ – First Principal Component
P₂ – Second Principal Component
P₃ – Third Principal Component

Thus, first principal component is most important to capture the influencing factors for agricultural development in each state, which has shown maximum eigen value and accounted for more than 60 per cent of variances. If the first principal component alone explains more than 50 per cent of the total variance, then one set of component scores is enough to analyze the development (Sarker, 1994). So, the first principal component was taken into consideration to identify the major factors responsible for agricultural development in each state separately.

4.2.2 State-wise Identification of Major Factors Responsible for Agricultural Development

In the previous section, it has been identified that the indicators were not evenly distributed across the states and over the time periods within states also, which indicate heterogeneity among the indicators. Due to this heterogeneous type of distribution of the indicators, the factors responsible for agricultural development may be quite different from state to state. Hence, state wise analysis will reveal potential factors of agricultural development at the state level.

Andhra Pradesh

Andhra Pradesh prevailed as an agriculturally moderate developed state since 1971-72 though it deteriorated in 1975-76 and 1985-86 due to slow progress of most of the indicators. Since, some factors worked as a constrained while some showed potential for further development of the state. The potential factors were net irrigated area, area under HYVs, fertilizer consumption, foodgrain productivity, agricultural workers, pumpset, tractor, regulated market, electrified villages, electricity consumption in agriculture, density of rural roads,

rural literacy, net value of agricultural production, expenditure on agricultural research and education and per capita AgNSDP. Since, out of 22 indicators these 15 indicators showed higher coefficients and loadings and accounted for high variances in the principal component, all these indicators were positive factors for agricultural development (Table 4.9).

Assam

Assam has been represented as a developing state in agriculture since 1971-72 to 1985-86 though its CADIs decreased and came under the group of less developed states after 1990-91. Because, there was not so much development and growth in the indicators and could not be benefited by the modern agricultural technology due to lack of infrastructure and socio-economic backwardness. However, most of the indicators had shown high coefficients and loadings and accounted for high variances in the principal component, i.e., cropping intensity, area under HYVs, fertilizer consumption, foodgrain productivity, agricultural workers, livestock density, pumpset, regulated market, electrified villages, electricity consumption in agriculture, density of rural roads, rural literacy, net value of agricultural production, expenditure on agricultural research and education, expenditure on extension and per capita AgNSDP (Table 4.10). Moreover, net sown area showed moderate coefficient and loading but variance accounted was not so high. Out of 22 indicators, 16 indicators had shown their potentiality in this state.

In comparison to other states, status of the indicators were showing very less since 1970-71, but the changes in the indicators over the time periods had been captured 79 per cent of total variance by the first principal component of

Assam. Besides, little changes of the indicators were fluctuating over the time periods, which tend to the state backward in agricultural development.

Table 4.9 Principal component parameters and eigen value of Andhra Pradesh

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.14	0.55	0.31	0.45
Irrigation Intensity	0.03	0.12	0.02	0.70
Net Sown Area	-0.15	-0.58	0.34	0.75
Net Irrigated Area	0.24	0.95	0.89	0.91
Area under HYVs	0.24	0.96	0.91	0.95
Fertilizer Consumption	0.24	0.96	0.93	0.93
Foodgrain Productivity	0.24	0.97	0.94	0.96
Agricultural Workers	0.24	0.97	0.94	0.99
Livestock Density	-0.01	-0.05	0.00	0.86
Pumpset	0.25	0.99	0.99	1.00
Tractor	0.25	0.98	0.95	0.99
Regulated Market	0.24	0.95	0.90	0.91
Electrified Villages	0.23	0.93	0.87	0.96
Electricity Consumption in Agriculture	0.22	0.87	0.76	0.86
Density of Rural Roads	0.24	0.97	0.94	0.99
Primary Agricultural Cooperative Society	-0.22	-0.87	0.75	0.90
Rural Literacy	0.25	0.99	0.99	0.99
Net Value of Agricultural Production	0.23	0.91	0.83	0.97
Expenditure on Agricultural Research and Education	0.24	0.94	0.88	0.97
Expenditure on Extension	0.03	0.13	0.02	0.88
Share of AgNSDP	-0.24	-0.94	0.88	0.96
Per Capita AgNSDP	0.23	0.91	0.83	0.97
Variance (Eigen Value)	15.88		15.88	
Percent of total variance	72.20			

Table 4.10 Principal component parameters and eigen value of Assam

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.93	0.87	0.92
Irrigation Intensity	0.15	0.63	0.40	0.90
Net Sown Area	0.17	0.72	0.52	0.94
Net Irrigated Area	-0.18	-0.73	0.53	0.96
Area under HYVs	0.22	0.90	0.81	0.91
Fertilizer Consumption	0.22	0.91	0.84	0.93
Foodgrain Productivity	0.22	0.90	0.80	0.88
Agricultural Workers	0.23	0.97	0.95	0.95
Livestock Density	0.20	0.83	0.69	0.96
Pumpset	0.23	0.94	0.87	0.93
Tractor	0.15	0.63	0.40	0.64
Regulated Market	0.23	0.97	0.95	0.96
Electrified Villages	0.24	0.99	0.97	0.99
Electricity Consumption in Agriculture	0.22	0.91	0.83	0.85
Density of Rural Roads	0.24	0.99	0.98	0.99
Primary Agricultural Cooperative Society	-0.22	-0.93	0.87	0.92
Rural Literacy	0.22	0.91	0.83	0.99
Net Value of Agricultural Production	0.23	0.94	0.88	0.99
Expenditure on Agricultural Research and Education	0.23	0.94	0.88	0.96
Expenditure on Extension	0.22	0.93	0.87	0.94
Share of AgNSDP	-0.19	-0.78	0.61	0.93
Per Capita AgNSDP	0.23	0.95	0.90	0.99
Variance (Eigen Value)	17.26		17.26	
Percent of total variance	78.50			

Bihar

Bihar is predominantly an agricultural state having limited land resources. But according to the CADIs it has been classified as agriculturally moderate developed state during the entire period of study. Table 4.11 shows the principal component parameters of Bihar state. It revealed that most of the indicators show high coefficients and loadings and accounted for high variances except the cropping intensity, irrigation intensity, net sown area, primary agricultural cooperative society and share of AgNSDP (Table 4.11). Moreover, electricity consumption in agriculture showed high coefficient and loading but variance and communality were not so high. Thus, other than these indicators are important factors of agricultural development in Bihar.

Gujarat

In Gujarat, the agricultural sector continues to play a leading role in the economy, though the state is basically developed industrially. The constraints of agricultural development are geo-physical features and scarcity of irrigation sources though it's varying considerably from place to place and time to time (Joshi, 1986). In spite of industrially based state, Gujarat is classified as an agriculturally developing state, though its indices had declined in 1975-76 and 1985-86 but for most of the periods showed positive trends. In the principal component, almost all indicators showed high coefficients and loadings and accounted for high variances except cropping intensity, net sown area, primary agricultural cooperative society and share of AgNSDP. Besides, foodgrain productivity and pumpset accounted for less variances that indicate also low potentiality of these indicators.

Table 4.11 Principal component parameters and eigen value of Bihar

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.14	0.58	0.33	0.96
Irrigation Intensity	0.05	0.21	0.04	0.70
Net Sown Area	-0.22	-0.89	0.80	0.88
Net Irrigated Area	0.23	0.94	0.88	0.96
Area under HYVs	0.21	0.87	0.75	0.79
Fertilizer Consumption	0.23	0.97	0.94	0.96
Foodgrain Productivity	0.22	0.89	0.80	0.87
Agricultural Workers	0.24	0.97	0.95	0.99
Livestock Density	0.24	0.98	0.97	0.99
Pumpset	0.22	0.93	0.86	0.94
Tractor	0.21	0.86	0.75	0.95
Regulated Market	0.23	0.93	0.87	0.98
Electrified Villages	0.24	0.98	0.97	0.97
Electricity Consumption in Agriculture	0.19	0.79	0.62	0.72
Density of Rural Roads	0.24	0.97	0.95	0.95
Primary Agricultural Cooperative Society	-0.19	-0.78	0.62	0.80
Rural Literacy	0.24	0.99	0.98	0.99
Net Value of Agricultural Production	0.22	0.93	0.86	0.97
Expenditure on Agricultural Research and Education	0.22	0.91	0.82	0.93
Expenditure on Extension	0.20	0.82	0.67	0.83
Share of AgNSDP	-0.21	-0.88	0.78	0.88
Per Capita AgNSDP	0.23	0.93	0.87	0.97
Variance (Eigen Value)	17.07		17.07	
Percent of total variance	77.60			

Table 4.12 Principal component parameters and eigen value of Gujarat

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.15	0.60	0.37	0.81
Irrigation Intensity	0.22	0.89	0.79	0.80
Net Sown Area	-0.04	-0.15	0.02	0.90
Net Irrigated Area	0.24	0.98	0.96	0.98
Area under HYVs	0.23	0.94	0.89	0.93
Fertilizer Consumption	0.24	0.97	0.94	0.96
Foodgrain Productivity	0.13	0.54	0.29	0.86
Agricultural Workers	0.22	0.87	0.76	0.99
Livestock Density	0.21	0.83	0.69	0.93
Pumpset	0.18	0.74	0.54	0.97
Tractor	0.25	0.99	0.98	0.98
Regulated Market	0.22	0.88	0.77	0.81
Electrified Villages	0.23	0.94	0.89	0.97
Electricity Consumption in Agriculture	0.22	0.90	0.81	0.88
Density of Rural Roads	0.24	0.98	0.97	0.97
Primary Agricultural Cooperative Society	-0.21	-0.87	0.75	0.86
Rural Literacy	0.25	0.99	0.99	0.99
Net Value of Agricultural Production	0.22	0.88	0.78	0.97
Expenditure on Agricultural Research and Education	0.23	0.93	0.87	0.99
Expenditure on Extension	0.24	0.96	0.93	0.98
Share of AgNSDP	-0.18	-0.72	0.52	0.63
Per Capita AgNSDP	0.22	0.87	0.76	0.96
Variance (Eigen Value)	16.25		16.25	
Percent of total variance	73.90			

Out of 22 indicators, changes of 16 indicators during the entire period were satisfactory to show their potentiality in agricultural development of Gujarat. However, this state was not highly developed from the very beginning in comparison to other states, even it showed the progress due to growth of potential indicators but the growth was not sufficient for rapid agricultural development in the state.

Haryana

Haryana is an agriculturally developed state and agriculture has been the main driving force of the state's economic development. In this study, it was found that the state belonged to developed category and is always at second position among the major states since 1971-72. The principal component showed that the coefficients and loadings of all the indicators were high and accounted for high variances except the net sown area, primary agricultural cooperative society, expenditure on extension and share of AgNSDP (Table 4.13). Besides, irrigation intensity and electrified villages showed high coefficients and loadings but accounted for moderate variances and expenditure on extension accounted for less variance. So, out of 22 indicators, 16 indicators had shown their potentiality in agricultural development in the entire study period. Since most of the indicators strongly influenced development the agriculture sector, as a result, agricultural development progressed tremendously in Haryana.

Himachal Pradesh

In Himachal Pradesh, most of the region is occupied by the precipitous hills with abundance of snowmelt water yet the percentage of cultivated area to the total cultivable area is considerably low so the foodgrain production is low (Siddiqi *et al.*, 1989). But, the state prevailed as an agriculturally moderate developed category from the beginning, though during the study period it changed ranking position due to change of composite indices.

Table 4.13 Principal component parameters and eigen value of Haryana

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.21	0.84	0.71	0.88
Irrigation Intensity	0.19	0.76	0.58	0.65
Net Sown Area	-0.05	-0.19	0.04	0.92
Net Irrigated Area	0.24	0.97	0.94	0.98
Area under HYVs	0.21	0.86	0.73	0.95
Fertilizer Consumption	0.24	0.96	0.92	0.93
Foodgrain Productivity	0.24	0.97	0.93	0.94
Agricultural Workers	0.23	0.93	0.86	0.98
Livestock Density	0.22	0.90	0.82	0.96
Pumpset	0.24	0.99	0.97	0.98
Tractor	0.24	0.98	0.97	0.99
Regulated Market	0.24	0.97	0.94	0.94
Electrified Villages	0.17	0.71	0.51	0.74
Electricity Consumption in Agriculture	0.22	0.89	0.80	0.89
Density of Rural Roads	0.23	0.92	0.85	0.97
Primary Agricultural Cooperative Society	-0.16	-0.66	0.43	0.82
Rural Literacy	0.24	0.97	0.94	0.98
Net Value of Agricultural Production	0.22	0.91	0.83	0.97
Expenditure on Agricultural Research and Education	0.23	0.95	0.89	0.98
Expenditure on Extension	0.10	0.42	0.18	0.73
Share of AgNSDP	-0.23	-0.94	0.88	0.93
Per Capita AgNSDP	0.22	0.92	0.84	0.97
Variance (Eigen Value)	16.55		16.55	
Percent of total variance	75.20			

Through the principal component parameters, it was found that the coefficients and loadings were low and accounted for less variances in case of irrigation intensity, net sown area, net irrigated area, livestock density, electricity consumption in agriculture, primary agricultural cooperative society

and share of AgNSDP. Besides cropping intensity, foodgrain productivity and regulated market showed high coefficients and loadings but accounted for moderate variances that also indicate low potentiality of these indicators. Rest of the indicators showed high coefficients and loadings and accounted for high variances (Table 4.14). In this state, the growth of the 12 indicators was potential to contribute the agricultural development during the study period. Since, changes of the all indicators over the time periods were not consistent and satisfactory to show the potentiality in agricultural development. Due to this reason, agricultural development was sometimes distorted in the state and the ranking position had gone down though state belonged to moderate developed category all the time periods.

Jammu & Kashmir

The location of the state is unique in terms of geophysical conditions. It has a number of different ecological belts influencing the agricultural operations in different ways. Besides, the agricultural technology is unevenly distributed in the state. While the Jammu region enjoys 75 per cent of the total modern technology of the state then 25 per cent is concentrated in Kashmir valley. But the productivity in Jammu region is much lower than the Kashmir valley because of the low response to technology and adverse environmental factors (Siddiqi, *et al.*, 1989).

This state showed the convergent trend in agricultural development and it came up to moderate developed category from developing category since 1985-86. In this state, mostly all indicators showed high coefficients and loadings and accounted for high variances, except the net irrigated area, primary

agricultural cooperative society and share of AgNSDP, but irrigation intensity, foodgrain productivity and electricity consumption in agriculture which showed high loadings but accounted for moderate variances in the principal component (Table 4.15).

Table 4.14 Principal component parameters and eigen value of Himachal Pradesh

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.19	0.75	0.56	0.62
Irrigation Intensity	0.01	0.03	0.00	0.89
Net Sown Area	-0.24	-0.94	0.89	0.90
Net Irrigated Area	0.15	0.59	0.35	0.94
Area under HYVs	0.23	0.90	0.81	0.86
Fertilizer Consumption	0.25	0.96	0.92	0.97
Foodgrain Productivity	0.20	0.79	0.62	0.71
Agricultural Workers	0.25	0.97	0.94	0.98
Livestock Density	0.12	0.46	0.21	0.91
Pumpset	0.23	0.89	0.79	0.80
Tractor	0.25	0.96	0.92	0.99
Regulated Market	0.18	0.70	0.49	0.94
Electrified Villages	0.24	0.94	0.89	0.98
Electricity Consumption in Agriculture	0.04	0.15	0.02	0.92
Density of Rural Roads	0.24	0.93	0.87	0.92
Primary Agricultural Cooperative Society	-0.21	-0.81	0.66	0.95
Rural Literacy	0.25	0.99	0.98	0.99
Net Value of Agricultural Production	0.24	0.93	0.86	0.98
Expenditure on Agricultural Research and Education	0.23	0.90	0.80	0.96
Expenditure on Extension	0.23	0.89	0.79	0.88
Share of AgNSDP	-0.24	-0.94	0.88	0.95
Per Capita AgNSDP	0.24	0.95	0.90	0.99
Variance (Eigen Value)	15.16		15.16	
Percent of total variance	68.90			

Table 4.15 Principal component parameters and eigen value of Jammu & Kashmir

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.24	0.95	0.91	0.95
Irrigation Intensity	0.18	0.71	0.50	0.89
Net Sown Area	0.21	0.84	0.71	0.76
Net Irrigated Area	0.08	0.32	0.10	0.93
Area under HYVs	0.20	0.81	0.66	0.77
Fertilizer Consumption	0.23	0.93	0.86	0.91
Foodgrain Productivity	0.18	0.73	0.54	0.59
Agricultural Workers	0.24	0.96	0.92	0.96
Livestock Density	0.25	0.99	0.98	0.99
Pumpset	0.24	0.96	0.91	0.95
Tractor	0.23	0.92	0.84	0.93
Regulated Market	NA	NA	NA	NA
Electrified Villages	0.24	0.94	0.89	0.99
Electricity Consumption in Agriculture	0.19	0.75	0.57	0.93
Density of Rural Roads	0.25	1.00	0.99	0.99
Primary Agricultural Cooperative Society	-0.22	-0.87	0.76	0.79
Rural Literacy	0.25	0.99	0.98	0.99
Net Value of Agricultural Production	0.22	0.90	0.81	0.96
Expenditure on Agricultural Research and Education	0.22	0.87	0.75	0.88
Expenditure on Extension	0.23	0.91	0.82	0.97
Share of AgNSDP	-0.21	-0.86	0.74	0.91
Per Capita AgNSDP	0.23	0.92	0.85	0.96
Variance (Eigen Value)	16.09		16.09	
Percent of total variance	76.60			

Note: Regulated market act not passed in Jammu and Kashmir.

Since, most of the indicators showed their potentiality in agricultural development altogether though the counter balance of the less potential indicators had minimized their influence to some extent. Therefore, the state moved forward in the process of agricultural development.

Karnataka

The situation of agriculture in Karnataka is different from other states, because the state presents a most representative situation mainly on account of geographical factors. However, the state had not showed the remarkable achievement in agriculture in comparison to other states. But, the indices had shown the convergent trend over the period. Basically, this state was lagging behind in agriculture from the beginning (1970-71). It is revealed from the principal component that all the indicators showed high coefficients and loadings and accounted for high variances, with exception in case of irrigation intensity, net sown area, primary agricultural cooperative society and share of AgNSDP (Table 4.16). However, irrigation intensity and net sown area showed moderate loadings but got the low variances, whereas foodgrain productivity and livestock density showed high loadings but accounted for moderate variances, so these factors had low contribution in the progress of the state. Since, out of 22 indicators, changes of 16 indicators showed their potentiality in the entire period, as a result, the agriculture sector developed.

Kerala

Kerala is primarily an agricultural state and it is very rich in the production of cash crops like coconut, cashewnut, pepper, rubber etc. However, it could not maintain the development pace throughout the time periods. It is categorized as an agriculturally moderate developed state but its rank had gone down especially after 1990-91, because the growth of the indicators was not consistent and satisfactory over the time periods.

Table 4.16 Principal component parameters and eigen value of Karnataka

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.23	0.95	0.92	0.94
Irrigation Intensity	0.14	0.60	0.36	0.44
Net Sown Area	0.13	0.56	0.32	0.90
Net Irrigated Area	0.23	0.97	0.95	0.95
Area under HYVs	0.23	0.95	0.91	0.94
Fertilizer Consumption	0.23	0.96	0.93	0.95
Foodgrain Productivity	0.19	0.78	0.61	0.81
Agricultural Workers	0.22	0.95	0.89	0.99
Livestock Density	0.18	0.78	0.60	0.96
Pumpset	0.23	0.99	0.97	0.98
Tractor	0.23	0.97	0.95	0.97
Regulated Market	0.23	0.97	0.94	0.97
Electrified Villages	0.21	0.90	0.81	0.96
Electricity Consumption in Agriculture	0.22	0.94	0.89	0.91
Density of Rural Roads	0.23	0.99	0.97	0.98
Primary Agricultural Cooperative Society	-0.19	-0.78	0.60	0.87
Rural Literacy	0.24	0.99	0.98	0.99
Net Value of Agricultural Production	0.22	0.92	0.85	0.99
Expenditure on Agricultural Research and Education	0.22	0.94	0.89	0.99
Expenditure on Extension	0.23	0.96	0.92	0.93
Share of AgNSDP	-0.20	-0.85	0.71	0.91
Per Capita AgNSDP	0.22	0.93	0.86	0.99
Variance (Eigen Value)	17.86		17.86	
Percent of total variance	81.20			

Tables 4.17 revealed that out of 22 indicators, growth of 9 indicators were not considerably potential to promote the agricultural development. These indicators were cropping intensity, irrigation intensity, net sown area, area under HYVs, regulated market, electricity consumption in agriculture, primary agricultural cooperative society, expenditure on extension and share of

AgNSDP. These indicators had low coefficients and loadings and accounted for less variances in the principal component of Kerala. Due to lack of potentiality of all indicators, the CADIs showed the divergent trend and Kerala moved down in ranking, even though it ahead as a moderately developed state category.

Table 4.17 Principal component parameters and eigen value of Kerala

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	-0.03	-0.11	0.01	0.68
Irrigation Intensity	-0.22	-0.81	0.66	0.89
Net Sown Area	-0.05	-0.20	0.04	0.34
Net Irrigated Area	0.26	0.95	0.91	0.96
Area under HYVs	0.10	0.37	0.13	0.57
Fertilizer Consumption	0.24	0.89	0.79	0.82
Foodgrain Productivity	0.25	0.92	0.85	0.91
Agricultural Workers	0.21	0.78	0.61	0.87
Livestock Density	0.23	0.85	0.73	0.93
Pumpset	0.25	0.92	0.85	0.86
Tractor	0.22	0.82	0.67	0.80
Regulated Market	-0.17	-0.62	0.38	0.72
Electrified Villages	0.20	0.74	0.55	0.87
Electricity Consumption in Agriculture	-0.03	-0.11	0.01	0.62
Density of Rural Roads	0.27	0.99	0.98	0.98
Primary Agricultural Cooperative Society	-0.21	-0.75	0.56	0.96
Rural Literacy	0.27	0.99	0.99	0.99
Net Value of Agricultural Production	0.24	0.87	0.75	0.92
Expenditure on Agricultural Research and Education	0.25	0.90	0.80	0.94
Expenditure on Extension	0.17	0.60	0.36	0.88
Share of AgNSDP	-0.26	-0.94	0.89	0.89
Per Capita AgNSDP	0.24	0.87	0.75	0.92
Variance (Eigen Value)	13.30		13.30	
Percent of total variance	60.40			

Madhya Pradesh

Madhya Pradesh is one of the less developed states, though agriculture is the mainstay of state's economy. It had shown advancement in agriculture but that was not quite impressive in comparison to other states. In principal component, most of the indicators showed high coefficients and loadings and accounted for high variances, whereas the irrigation intensity, net sown area, livestock density, primary agricultural cooperative society and share of AgNSDP had very low coefficients and loadings and accounted for less variances and expenditure on extension had moderate coefficient and loading but explained less variance (Table 4.18). So out of 22 indicators, 16 indicators got the high coefficients and loadings with high variances in the principal component. The changes over the time periods of these indicators were the potential factors for agricultural development in Madhya Pradesh. However, the state did not enjoy a comfortable position in regards to distribution of the indicators and modern inputs in comparison to other states, which were the main reasons for it lagging behind the other states. Since, efficient utilization of modern inputs helps to acquire the potential agricultural development of the state.

Maharashtra

Maharashtra is one of the agriculturally backward states and is characterized as drought prone region with erratic rainfall. Moreover, the frequencies of dry spells affect adversely the fertility and productivity of the state (Siddiqi *et al.*, 1989). The state was classified as less developed category in 1971-72 and afterwards it moved in developing groups. The absolute indices of the state nearly doubled and relative rank moved up between the period 1971-72 and

1995-96. By the principal component, it is revealed that except irrigation intensity, net sown area, primary agricultural cooperative society and share of AgNSDP, all other indicators showed high coefficients and loadings and accounted for high variances and rural literacy showed moderate loading but low variance (Table 4.19).

Table 4.18 Principal component parameters and eigen value of Madhya Pradesh

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.23	0.94	0.89	0.97
Irrigation Intensity	-0.11	-0.45	0.20	0.59
Net Sown Area	-0.02	-0.07	0.00	0.89
Net Irrigated Area	0.24	0.99	0.97	0.99
Area under HYVs	0.24	0.98	0.96	0.96
Fertilizer Consumption	0.24	0.97	0.95	0.97
Foodgrain Productivity	0.22	0.92	0.85	0.91
Agricultural Workers	0.23	0.93	0.87	0.97
Livestock Density	0.07	0.31	0.09	0.71
Pumpset	0.24	1.00	1.00	1.00
Tractor	0.24	0.98	0.97	0.99
Regulated Market	0.24	0.97	0.95	0.96
Electrified Villages	0.24	0.98	0.97	0.98
Electricity Consumption in Agriculture	0.22	0.92	0.84	0.94
Density of Rural Roads	0.24	0.98	0.97	0.98
Primary Agricultural Cooperative Society	-0.17	-0.69	0.48	0.65
Rural Literacy	0.24	0.99	0.98	0.99
Net Value of Agricultural Production	0.23	0.95	0.91	0.97
Expenditure on Agricultural Research and Education	0.23	0.92	0.86	0.89
Expenditure on Extension	0.17	0.70	0.49	0.50
Share of AgNSDP	-0.22	-0.89	0.79	0.87
Per Capita AgNSDP	0.23	0.95	0.91	0.97
Variance (Eigen Value)	16.90		16.90	
Percent of total variance	76.80			

Table 4.19 Principal component parameters and eigen value of Maharashtra

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.89	0.80	0.85
Irrigation Intensity	0.08	0.31	0.09	0.81
Net Sown Area	0.06	0.23	0.05	0.82
Net Irrigated Area	0.24	0.95	0.91	0.91
Area under HYVs	0.24	0.98	0.97	0.98
Fertilizer Consumption	0.24	0.96	0.92	0.94
Foodgrain Productivity	0.21	0.83	0.68	0.90
Agricultural Workers	0.24	0.97	0.94	0.98
Livestock Density	0.23	0.93	0.87	0.96
Pumpsets	0.23	0.92	0.85	0.95
Tractor	0.24	0.96	0.92	0.97
Regulated Market	0.24	0.98	0.95	0.98
Electrified Villages	0.24	0.96	0.92	0.98
Electricity Consumption in Agriculture	0.25	0.99	0.98	0.98
Density of Rural Roads	0.23	0.91	0.83	0.97
Primary Agricultural Cooperative Society	-0.04	-0.15	0.02	0.86
Rural Literacy	0.17	0.67	0.45	0.94
Net Value of Agricultural Production	0.23	0.91	0.84	0.96
Expenditure on Agricultural Research and Education	0.24	0.95	0.91	0.99
Expenditure on Extension	0.23	0.92	0.84	0.89
Share of AgNSDP	-0.20	-0.80	0.64	0.96
Per Capita AgNSDP	0.23	0.92	0.85	0.96
Variance (Eigen Value)	16.23		16.23	
Percent of total variance	73.80			

Thus, the growth of 17 indicators was satisfactory for contributing in agricultural development and these indicators emerged as potential factors, which played key role in agricultural development in the Maharashtra.

Orissa

Compared to other states of India, Orissa failed to make forward strides in agricultural development. The state is categorized as a less developed since 1971-72 and yet not has moved out from this group. This indicates that the state's progress was not quite reckonable for agricultural development. Though, there was presence of several adverse factors such as natural calamity and devastation, technological backwardness, lack of awareness and investment in agriculture, etc. In spite of obstruction by several adverse factors, agricultural potentials had not been properly utilized in this state. Hence, the state needs assured supply of modern inputs and implementation of new technology for the development of agriculture. It was observed that the irrigation intensity, agricultural workers, livestock density, tractor, primary agricultural cooperative society and share of AgNSDP showed low coefficients and loadings and accounted for low variances. Besides, net sown area, foodgrain productivity and expenditure on extension showed moderate coefficients and loadings but accounted for low variances in the principal component that also indicate less potential of these indicators (Table 4.20). As a result, out of 22 indicators, only 13 indicators emerge as potential indicators of agricultural development of Orissa. Thus, it might be that the counter-balance effect of other factors had led to slow pace of agricultural development and the state remained in less developed group. Thus, the proper policy and massive efforts are needed to explore the potentiality of agricultural development and it also helps to reduce the inequality of resources and gap across the states.

Table 4.20 Principal component parameters and eigen value of Orissa

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.88	0.78	0.96
Irrigation Intensity	-0.03	-0.12	0.02	0.64
Net Sown Area	0.18	0.70	0.48	0.85
Net Irrigated Area	0.24	0.95	0.90	0.94
Area under HYVs	0.25	0.99	0.98	0.99
Fertilizer Consumption	0.25	0.97	0.94	0.97
Foodgrain Productivity	0.19	0.76	0.58	0.76
Agricultural Workers	0.12	0.49	0.24	0.96
Livestock Density	-0.02	-0.09	0.01	0.88
Pumpsets	0.25	0.99	0.99	0.99
Tractor	0.15	0.60	0.36	0.91
Regulated Market	0.24	0.96	0.91	0.93
Electrified Villages	0.25	0.99	0.97	0.98
Electricity Consumption in Agriculture	0.23	0.92	0.86	0.89
Density of Rural Roads	0.25	0.98	0.96	0.98
Primary Agricultural Cooperative Society	-0.21	-0.82	0.67	0.93
Rural Literacy	0.25	0.99	0.98	0.99
Net Value of Agricultural Production	0.23	0.91	0.83	0.91
Expenditure on Agricultural Research and Education	0.23	0.91	0.82	0.91
Expenditure on Extension	0.19	0.74	0.55	0.57
Share of AgNSDP	-0.24	-0.95	0.90	0.91
Per Capita AgNSDP	0.24	0.94	0.88	0.90
Variance (Eigen Value)	15.61		15.61	
Percent of total variance	71.00			

Punjab

Punjab is one of the most progressive states in India. The impressive growth rates achieved in agricultural production and have been widely acclaimed as a success of the agricultural strategy centered on the green revolution technology in Punjab. There is a widespread belief that the 'Punjab pattern of agricultural development' and green revolution technology are the best route for agricultural development in other parts of the country. The general impression about Punjab agriculture is that it is highly productive, continues to have vast potential for growth, and provides good farm income to producers (Chand, 1999). Having this background of the state, it was found that Punjab always showed the leading state in agricultural development and never fell down in its ranking position and had higher CADIs than the other states all through the periods. In the principal component, most of the indicators showed high coefficients and loadings and accounted for high variances, whereas the negative and low coefficients and loadings was received in case of livestock density, primary agricultural cooperative society, expenditure on extension and share of AgNSDP, whereas net sown area and agricultural workers accounted for moderate variance though these indicators showed high coefficient and loading (Table 4.21). Since, out of 22 indicators, 16 indicators showed their potentiality, as result of, significant growth of these indicators over the time was remarkable to influence the agricultural development in the state. Thus, the positive role of the potential indicators to a great extent has influenced agricultural development in Punjab.

Table 4.21 Principal component parameters and eigen value of Punjab

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.24	0.99	0.98	0.99
Irrigation Intensity	0.24	0.97	0.94	0.95
Net Sown Area	0.16	0.67	0.44	0.83
Net Irrigated Area	0.23	0.97	0.94	0.94
Area under HYVs	0.22	0.92	0.85	0.96
Fertilizer Consumption	0.23	0.96	0.91	0.96
Foodgrain Productivity	0.24	0.98	0.97	0.98
Agricultural Workers	0.18	0.73	0.53	0.95
Livestock Density	-0.22	-0.89	0.79	0.95
Pumpset	0.23	0.96	0.93	0.95
Tractor	0.21	0.88	0.77	0.96
Regulated Market	0.23	0.93	0.87	0.88
Electrified Villages	0.20	0.84	0.70	0.93
Electricity Consumption in Agriculture	0.22	0.92	0.84	0.85
Density of Rural Roads	0.24	1.00	0.99	0.99
Primary Agricultural Cooperative Society	-0.20	-0.84	0.71	0.87
Rural Literacy	0.24	0.97	0.95	0.99
Net Value of Agricultural Production	0.20	0.83	0.69	0.98
Expenditure on Agricultural Research and Education	0.21	0.86	0.75	0.95
Expenditure on Extension	-0.03	-0.12	0.01	0.99
Share of AgNSDP	-0.21	-0.88	0.77	0.95
Per Capita AgNSDP	0.20	0.84	0.71	0.98
Variance (Eigen Value)	17.05		17.05	
Percent of total variance	77.50			

Rajasthan

From the point of view of its geophysical condition, Rajasthan is one of the most disadvantageous state. There are marked variations in the various parts of the state in the matters of rainfall, soil structure, soil fertility and moisture retaining capacity. The geophysical, institutional and technological factors like higher rate of evaporation, large size of land holdings, and distribution of technology are also important for agriculture in Rajasthan (Siddiqi *et al.*, 1989). The state is classified under the less developed category, though it improved its CADIs in 1980s decade but again declined in 1990s decade. According to the principal component coefficients, loadings and variances, it was found that irrigation intensity, net sown area, livestock density, primary agricultural cooperative society and share of AgNSDP were not potential to contribute considerably in agricultural development. Besides, foodgrain productivity, electricity consumption in agriculture and expenditure on extension accounted moderate variances, however, had high coefficients and loadings, that also indicate less potentiality of these factors and other indicators showed their potentiality in agricultural development (Table 4.22). Therefore, the changes of these indicators over the time periods were not significant to contribute in agricultural development in the state. Hence, it is needed to mitigate the inequalities of resources and to remove the obstacles of adoption of modern technologies in the state for reducing the disparities.

Table 4.22 Principal component parameters and eigen value of Rajasthan

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.88	0.78	0.81
Irrigation Intensity	0.11	0.42	0.18	0.64
Net Sown Area	0.11	0.42	0.18	0.93
Net Irrigated Area	0.23	0.92	0.85	0.95
Area under HYVs	0.23	0.91	0.83	0.92
Fertilizer Consumption	0.24	0.95	0.90	0.97
Foodgrain Productivity	0.19	0.73	0.54	0.79
Agricultural Workers	0.21	0.84	0.71	0.91
Livestock Density	0.10	0.40	0.16	0.85
Pumpset	0.25	0.99	0.97	0.98
Tractor	0.25	0.99	0.98	0.99
Regulated Market	0.22	0.88	0.78	0.92
Electrified Villages	0.22	0.88	0.78	0.95
Electricity Consumption in Agriculture	0.19	0.76	0.58	0.81
Density of Rural Roads	0.25	0.98	0.97	0.97
Primary Agricultural Cooperative Society	-0.16	-0.62	0.38	0.81
Rural Literacy	0.25	0.99	0.99	1.00
Net Value of Agricultural Production	0.23	0.93	0.86	0.97
Expenditure on Agricultural Research and Education	0.24	0.94	0.89	0.98
Expenditure on Extension	0.20	0.78	0.61	0.64
Share of AgNSDP	-0.24	-0.93	0.87	0.91
Per Capita AgNSDP	0.23	0.91	0.83	0.96
Variance (Eigen Value)	15.61		15.61	
Percent of total variance	71.00			

Tamil Nadu

Tamil Nadu is located in a most advantageous location in terms of rainfall, soil and geophysical factors. Fortunately enough, the environmental and human factors have been playing a positive role in the development of agriculture in the state (Siddiqi *et al.*, 1989). Since, the state adopted modern technology in agriculture from the early period of Green Revolution and remained as agriculturally developed category since 1971-72. Afterwards, progress of the state was very slow due to very little growth in indicators. As a result, the state had gone down in moderately developed category in 1990-91, though it came back again in developed category and constantly holds third rank since 1971-72, because from the beginning it was as agriculturally developed state. So, most of the indicators have positively contributed to the development in agriculture, though there were a few indicators noted as constraint, these were cropping intensity, irrigation intensity, net sown area, net irrigated area, livestock density, electricity consumption in agriculture, primary agricultural cooperative society and share of AgNSDP, which had low coefficients and loadings and accounted for less variances (Table 4.23). Therefore, out of 22 indicators, 14 indicators were noticed as potential indicators. It clearly indicates that if all the indicators had shown their potentiality in agricultural development then the state's development would have been more progressive. Hence, the significant contribution of all the indicators is essential to further speed up the agricultural development in the state.

Table 4.23 Principal component parameters and eigen value of Tamil Nadu

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	-0.10	-0.38	0.14	0.81
Irrigation Intensity	0.13	0.49	0.24	0.91
Net Sown Area	-0.09	-0.33	0.11	0.78
Net Irrigated Area	0.18	0.67	0.45	0.80
Area under HYVs	0.26	1.00	0.99	1.00
Fertilizer Consumption	0.25	0.95	0.91	0.93
Foodgrain Productivity	0.26	0.99	0.98	1.00
Agricultural Workers	0.23	0.88	0.77	0.80
Livestock Density	0.18	0.69	0.48	0.79
Pumpset	0.24	0.92	0.84	0.93
Tractor	0.25	0.95	0.91	0.92
Regulated Market	0.24	0.93	0.86	1.00
Electrified Villages	0.26	0.98	0.95	1.00
Electricity Consumption in Agriculture	0.09	0.36	0.13	0.19
Density of Rural Roads	0.26	0.99	0.98	1.00
Primary Agricultural Cooperative Society	-0.13	-0.51	0.26	0.61
Rural Literacy	0.26	0.99	0.98	0.99
Net Value of Agricultural Production	0.24	0.90	0.81	0.99
Expenditure on Agricultural Research and Education	0.20	0.75	0.56	0.91
Expenditure on Extension	0.25	0.96	0.92	0.99
Share of AgNSDP	-0.15	-0.58	0.34	0.98
Per Capita AgNSDP	0.25	0.94	0.89	0.99
Variance (Eigen Value)	14.50		14.50	
Percent of total variance	65.90			

Uttar Pradesh

Uttar Pradesh is one of the largest states of the country and a major producer of foodgrains but agricultural production has not shown a comparative marked improvement (Singh *et al.*, 1998). Moreover, the geophysical conditions of Uttar Pradesh are diversified, so is the level of regional imbalances in agricultural development. It creates also regional variations in structure of development in agriculture within the state. As a result, with the introduction of modern technologies gain have not been evenly distributed throughout the state, which adversely affected the agricultural development in Uttar Pradesh. However, this state is classified as agriculturally moderately developed since 1971-72 though it is located in developing group in the middle period in 1975-76 and 1980-81. It is inferred from the Table 4.24 that the net sown area, regulated market, primary agricultural cooperative society and share of AgNSDP had low coefficients and loadings and accounted for less variances and others had high coefficients and loadings and accounted for high variances in the principal component. It was observed that, out of 22 indicators, 18 indicators had shown their potentiality for agricultural development in the state. Therefore, efficient use of these resources throughout state is needed to reduce regional discrepancy and for balanced agricultural development in Uttar Pradesh.

Table 4.24 Principal component parameters and eigen value of Uttar Pradesh

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.92	0.85	0.90
Irrigation Intensity	0.23	0.96	0.92	0.97
Net Sown Area	0.07	0.28	0.08	0.97
Net Irrigated Area	0.23	0.97	0.95	0.97
Area under HYVs	0.23	0.96	0.93	0.97
Fertilizer Consumption	0.23	0.98	0.96	0.96
Foodgrain Productivity	0.23	0.97	0.94	0.95
Agricultural Workers	0.23	0.98	0.95	0.98
Livestock Density	0.23	0.98	0.96	0.98
Pumpset	0.23	1.00	0.99	1.00
Tractor	0.23	0.99	0.99	1.00
Regulated Market	0.14	0.60	0.36	0.81
Electrified Villages	0.23	0.98	0.96	0.98
Electricity Consumption in Agriculture	0.20	0.86	0.74	0.81
Density of Rural Roads	0.23	0.97	0.94	0.97
Primary Agricultural Cooperative Society	-0.16	-0.69	0.47	0.94
Rural Literacy	0.22	0.95	0.91	0.99
Net Value of Agricultural Production	0.22	0.93	0.86	0.98
Expenditure on Agricultural Research and Education	0.21	0.89	0.80	0.95
Expenditure on Extension	0.20	0.84	0.71	0.92
Share of AgNSDP	-0.22	-0.91	0.84	0.94
Per Capita AgNSDP	0.22	0.94	0.88	0.98
Variance (Eigen Value)	17.98		17.98	
Percent of total variance	81.70			

West Bengal

West Bengal is one of the important agricultural states whose economy is based on predominantly agriculture. Moreover, the state is located in an advantageous geophysical condition, which is favorable for agricultural operations. The fertility of soil in most of the areas is high and assured availability of rainfall with negligible variability is the chief geographical characteristic of the state (Siddiqi *et al.*, 1989). With all apposite conditions, the state had shown positively progressing trends, however it remained in a moderately developed category in agricultural development during the study period. Since, most of the indicators were associated with developmental progress by having the high coefficients and loadings and accounted for high variances, whereas irrigation intensity, net sown area, livestock density, primary agricultural cooperative society and share of AgNSDP were less associated by having low coefficients and loadings with low variances in the principal component (Table 4.25). Hence, out of 22 indicators, 17 indicators showed their potentiality and brought out terrific progress in agricultural development of West Bengal.

All India

Agriculture is the heart of Indian economy. The health and growth of economy depends on the sound and efficient functioning of the agricultural sector. Owing to this perception, it is often alleged that all the states in India have not witnessed a uniform growth in the process of agricultural development. It may have arisen out of the inherent differences in resource endowments or discrepancies among the potential resources being utilized in various states. There is a need to examine the all India status and to identify the factors

associated with it to compare the overall performance of agricultural development across the states.

Table 4.25 Principal component parameters and eigen value of West Bengal

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.91	0.82	0.90
Irrigation Intensity	0.16	0.64	0.41	0.59
Net Sown Area	-0.01	-0.05	0.00	0.90
Net Irrigated Area	0.21	0.84	0.71	0.92
Area under HYVs	0.24	0.97	0.94	0.97
Fertilizer Consumption	0.24	0.99	0.97	0.98
Foodgrain Productivity	0.23	0.93	0.87	0.94
Agricultural Workers	0.23	0.95	0.90	0.94
Livestock Density	0.13	0.54	0.29	0.95
Pumpset	0.24	0.99	0.98	0.99
Tractor	0.24	0.98	0.96	0.98
Regulated Market	0.23	0.96	0.92	0.94
Electrified Villages	0.24	0.98	0.96	0.98
Electricity Consumption in Agriculture	0.22	0.88	0.78	0.97
Density of Rural Roads	0.24	0.99	0.98	0.98
Primary Agricultural Cooperative Society	-0.17	-0.68	0.46	0.88
Rural Literacy	0.23	0.95	0.91	0.98
Net Value of Agricultural Production	0.22	0.91	0.84	0.98
Expenditure on Agricultural Research and Education	0.24	0.96	0.93	0.97
Expenditure on Extension	0.20	0.82	0.67	0.89
Share of AgNSDP	-0.17	-0.70	0.49	0.92
Per Capita AgNSDP	0.22	0.92	0.84	0.98
Variance (Eigen Value)	16.63		16.63	
Percent of total variance	75.60			

It was observed that the all India progress of agricultural development was always convergent over the time periods and its rank was almost static. Besides, all India was categorized in the developing group during the study period. Similar to the other states, the principal component showed that net sown area, primary agricultural cooperative society and share of AgNSDP were not contributing factors, besides all other indicators were potential for the development, and had high coefficients and loadings and accounted for high variances (Table 4.26). Therefore, most of the indicators had shown their potentiality to agricultural development in India.

From the above state-wise analysis, it was observed that all the indicators have not emerged as potential indicators and varied from state to state. Though, some of the common indicators were potential factors for all the states. However, net sown area, primary agricultural cooperative society and share of AgNSDP had shown divergent trend for all the states. Due to increase in population pressure, cultivated area has been diverted for other purposes which has acted as hindrance for agricultural development, because there is limited scope to enlarge the farmland. Another indicator primary agricultural cooperative society is the main source providing credit to the small and marginal farmers and it can ensure the use of modern technology and inputs, eventually, its number decreased, however, population has increased over the periods. Subsequently, the other sectors of the economy have grown up rapidly leading to declining share of AgNSDP. However, investment did not boost up in agriculture in comparison to other sectors of the economy. It is essential for technological advancement and balanced development in the country.

Consequently, it is needed that the proper strategic policy and its implementation be geared-up for the agricultural development, which minimized the unequal distribution of resources and modern technology across the states.

Table 4.26 Principal component parameters and eigen value of all India

Agricultural Development Indicators	Parameters			
	Coefficient	Loading	Variance	Communality
Cropping Intensity	0.22	0.99	0.98	0.99
Irrigation Intensity	0.22	0.97	0.94	0.97
Net Sown Area	0.07	0.33	0.11	1.00
Net Irrigated Area	0.22	1.00	0.99	0.99
Area under HYVs	0.22	0.98	0.97	0.98
Fertilizer Consumption	0.22	0.99	0.98	0.98
Foodgrain Productivity	0.22	0.98	0.96	0.98
Agricultural Workers	0.22	0.99	0.98	1.00
Livestock Density	0.21	0.94	0.89	0.98
Pumpset	0.22	0.98	0.96	0.97
Tractor	0.22	0.98	0.97	1.00
Regulated Market	0.22	0.96	0.92	0.97
Electrified Villages	0.22	0.99	0.97	0.99
Electricity Consumption in Agriculture	0.22	0.99	0.97	0.98
Density of Rural Roads	0.22	0.98	0.97	1.00
Primary Agricultural Cooperative Society	-0.20	-0.87	0.76	0.97
Rural Literacy	0.22	0.99	0.98	0.99
Net Value of Agricultural Production	0.21	0.91	0.83	0.99
Expenditure on Agricultural Research and Education	0.22	0.96	0.92	0.99
Expenditure on Extension	0.22	0.97	0.93	0.96
Share of AgNSDP	-0.21	-0.95	0.89	0.96
Per Capita AgNSDP	0.21	0.93	0.87	0.99
Variance (Eigen Value)	19.74		19.74	
Percent of total variance	89.70			

Since, it is concluded from these results, the country is not having similar resource base and the growth of the indicators is not identical across the states. As a result, the potential indicators varied state to state and due to large imbalances of the indicators uneven agricultural development took place. Hence, potentialities and problems of the states be identified and policy should be formulated and implemented to mitigate the disparities for balanced agricultural development.

4.3. Assessment of Contribution of the Potential Factors on Agricultural Development

Agricultural development is associated with multifaceted factors. The factors are attributed as indicators of agricultural development. Hence the development depends on the integrated effects of these indicators and satisfactory changes of these factors over the time. Therefore, the impact of the potential factors has been assessed by employing Principal Component Regression (PCR) for individual state and overall assessment is judged by introducing Cobb-Douglas type of function with intercept dummy to capture the region or states' effect on agricultural development.

4.3.1. State-wise Assessment of Contribution of the Potential Indicators on Agricultural Development

In this study, all the indicators are considered as positive factors for the agricultural development, however, all factors had not shown their potentiality in all the states. Further, the indicators are highly correlated with each others which might induce the multicollinearity effects in the Ordinary Least Squares

(OLS) estimation, but it is possible to avoid multicollinearity by using PCR. The potential factors have been identified by the PCA, which differed from state to state. The identified factors were the determinant of agricultural development for the state. The PCR estimates have measured the contribution of the potential indicators on agricultural development. Since, the estimates by the PCR have shown the standardized coefficients, which are comparable with each other. The estimates have been made by using the time series data of the selected potential indicators as explanatory variables and the constructed indices as dependent variable as state wise. The results of the PCR estimates have been presented in Table 4.27.

Andhra Pradesh

The estimated coefficients of Andhra Pradesh had been found significant and positive at 1 per cent level for all the indicators and the coefficient of multiple determination (R^2) was 0.82, which was also significant at one per cent level. It explained 82 percent of the total variation in the model. The coefficients of all the indicators were more or less at similar level that indicates nearly equal contribution made by the indicators to the development of agriculture in the state (Table 4.27). It implies that the state has progressed gradually and the included indicators have contributed significantly in the development of agriculture in Andhra Pradesh.

Assam

In the agricultural front, Assam has not been able to bring about impressive agricultural development. The estimated coefficients of all the potential indicators had been found negative though statistically not significant

and the coefficient of multiple determination (R^2) was 0.25, which was significant at 5 per cent level (Table 4.27). Thus, the estimates revealed that the growth of the indicators over the time periods was not at satisfactory level for the development of agriculture. Moreover, the state had shown divergent trend, because the coefficients have negatively contributed in agricultural development. Hence, it needs proper nourishment of the agricultural sector that could reduce the inter-state disparities as well as to increase the pace of development in the state.

Bihar

The potential indicators have been found 16 in Bihar, out of these indicators 10 had shown positive and 6 had shown negative coefficients, however, 5 positive and 2 negative coefficients were significant at the different levels and all others not significant (Table 4.27). The coefficient of multiple determination (R^2) was 0.53, which was significant at 1 per cent level. It reveals that the model could not explain 47 per cent variance by the included indicators. It might happen due to the growth of the indicators were not at satisfactory level to contribute to the agricultural development and other climatic and environmental factors which were not included in this model. In fact, development is an integration impact of all the indicators though most of the indicators did not attain reasonable changes over the time periods. As a result, it was identified that the CADIs of Bihar did not constantly follow the convergent trends. It needs positive and significant contribution of all the indicators for substantial development of the state.

Gujarat

In Gujarat state, out of 16 potential indicators, 14 indicators had shown positive coefficients, however, coefficients of 7 indicators were statistically significant and 7 were not significant. Besides, coefficient of 2 indicators had negative coefficients, though these were not statistically significant (Table 4.27). The coefficient of multiple determination (R^2) was 0.48, which was significant at one percent level, and it explained nearly half of the total variation. This implies that the changes of the indicators were more fluctuating over the time period and a few indicators were not growing at satisfactory level for contributing to the agricultural development of Gujarat. Thus, the less or negative contributory factors must be improved to play the effective role of development in the state.

Haryana

The coefficients of all 16 potential indicators of Haryana had been found positive though coefficients of 5 indicators were not statistically significant (Table 4.27). The coefficient of multiple determination (R^2) was 0.68, which was significant at 1 per cent level. It indicated that the changes of the non-significant indicators over the time periods were not having substantial impact on agricultural development. Since, the effective positive contribution of all indicators is the vital for the development and diminishing the inter-state disparities. It might be possible through proper utilization of the less or negative contributing factors which are inter-related with development indicators.

Himachal Pradesh

The coefficient of multiple determination (R^2) of Himachal Pradesh had not shown good enough to explain the total variation in the model though it was 0.18 and statistically significant at 10 per cent level. However, out of 12 potential indicators, 6 were positive and 6 were negative coefficients though not a single positive coefficient was significant due to large standard error. Among the 6 negative coefficients, 4 were significant at 5 per cent level (Table 4.27). It reveals that all the indicators have large standard errors, which reflected the changes over the time periods were very inconsistent and insignificant to support the development of agriculture in the state. In fact, the CADIs had been also found to show declining trend because of not positive changes of the indicators in comparison to other progressing states. The improvement in contributing indicators is needed for enhancing the agricultural development of the state, which ultimately reduces the developmental gap among the states.

Jammu and Kashmir

In Jammu and Kashmir, the estimated coefficients had been found to be positive and significant for all the potential indicators at one per cent level of significance and the coefficient of multiple determination (R^2) explained the 77 per cent of total variation in the model, which was also highly significant (Table 4.27). It implies that all the indicators had played most decisive task to improve the agricultural sector in Jammu and Kashmir over the time periods. Therefore, the state had always proceeded forward in agricultural development with the similar level of contribution made by all the indicators.

Karnataka

The multiple coefficient of determination (R^2) had been found 0.80, which was significant at 1 per cent level. In this state, out of 16 potential indicators, all indicators had shown positive coefficients except electrified villages, whose coefficient was negative but not significant. Among the positive coefficients, 6 were statistically significant and others were not significant (Table 4.27). It implies that all the potential factors of development were not sufficient level to contribute in agricultural development due to large variability of the indicators. Although, the state has gradually progressed in agriculture but the disparities across the states could be minimized through proper utilization of all the potential indicators in the state.

Kerala

The unique feature of Kerala is the predominance of cash crops in agriculture sector. This feature separated the state in agricultural development programs in comparison to other states. In this state, all the estimated coefficients of the indicators had been found negative except livestock density where this was only positive coefficient but not significant. Besides, out of 12 negative coefficients, 8 had been found significant at 1 per cent level of significance (Table 4.27). The coefficient of multiple determination (R^2) was 0.83, which was highly significant at one per cent level. It reveals that most of the indicators had negative contribution on the agricultural development of the state. Since, the changes of the potential indicators were not sufficient to enhance the agricultural sector though this state was better than other states in early stage and showed mostly stagnant situation all over the time periods.

Hence, it is required that all the indicators must positively and significantly contribute to the development process of the state.

Madhya Pradesh

Madhya Pradesh is a very disadvantageous state in agricultural development and is far behind the other states from the initial stage. Though, all the coefficients of the potential indicators of the state had been found positive and significant at one percent level of significance and the coefficient of multiple determination (R^2) was 0.85, which was also significant at one per cent level (Table 4.27). The coefficients were mostly at similar level for all the indicators. It implies that the all factors had contributed to the development of agriculture in the state but initial position was not at satisfactory level due to that state progress was very sluggish and the pace of development of the state had been very low.

Maharashtra

In Maharashtra, all the estimated coefficients of potential indicators had been found positive and significant at one per cent level and coefficient of multiple determination (R^2) was 0.69, which was also significant at one per cent level (Table 4.27). The coefficients indicate that all indicators had contributed in the development nearly at similar level. Though, all the indicators positively contributed but the initial gap of the resources among the states still exist which is required to be minimized for balance development of agriculture across the states.

Table 4.28. Standardized estimates of agricultural development indicators for the major states and all India

Indicators	Andhra Pradesh		Assam		Bihar		Gujarat		Haryana		Himachal Pradesh	
	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error	coefficient	standard error
Cropping Intensity	-	-	-0.0540	0.0546	-	-	-	-	0.0862*	0.0459	-0.0145	0.0931
Irrigation Intensity	-	-	-	-	-	-	0.0908	0.0803	-	-	-	-
Net Irrigated Area	0.1530**	0.0144	-	-	0.0632	0.0651	0.1578 ⁺	0.0874	0.1633**	0.0530	-	-
Area under HYVs	0.1537**	0.0145	-0.0763	0.0557	0.1488*	0.0587	0.1042	0.0841	0.2154**	0.0520	-0.3511*	0.1207
Fertilizer Consumption	0.1572**	0.0148	-0.0158	0.0553	0.0560	0.0673	0.1668 ⁺	0.0872	0.1076*	0.0521	-0.1978	0.1175
Foodgrain Productivity	0.1580**	0.0149	-0.0154	0.0539	-0.0877	0.0645	-	-	0.1058*	0.0521	-	-
Agricultural Workers	0.1556**	0.0147	-0.0378	0.0560	0.0491	0.0675	-0.0652	0.0877	0.1519*	0.0505	0.0316	0.1227
Livestock Density	-	-	0.0116	0.0564	0.0874	0.0680	-0.0272	0.0812	0.1303*	0.0490	-	-
Pumpset	0.1606**	0.0152	-0.0530	0.0549	-0.0981	0.0668	-	-	0.1254*	0.0534	-0.2549*	0.1160
Tractor	0.1597**	0.0151	-	-	0.4310**	0.0668	0.1035	0.0890	0.0914	0.0539	0.0622	0.1230
Regulated Market	0.1538**	0.0145	-0.0432	0.0560	0.3419**	0.0678	0.1526 ⁺	0.0801	0.1417*	0.0525	-	-
Electrified Villages	0.1491**	0.0141	-0.0582	0.0572	0.1984*	0.0683	0.0508	0.0845	-	-	-0.2739*	0.1180
Electricity Consumption in Agriculture	0.1441**	0.0136	-0.0355	0.0526	-	-	0.1347	0.0822	0.1407*	0.0492	-	-
Density of Rural Roads	0.1557**	0.0147	-0.0498	0.0571	0.2107**	0.0678	0.0872	0.0883	0.1880**	0.0522	-0.3469*	0.1230
Rural Literacy	0.1609**	0.0152	-0.0757	0.0554	0.0500	0.0685	0.1463	0.0893	0.0842	0.0533	-0.0323	0.1231
Net Value of Agricultural Production	0.1499**	0.0142	-0.0134	0.0566	-0.1271 ⁺	0.0683	0.2541*	0.0863	0.0307	0.0534	0.1152	0.1217
Expenditure on Agricultural Research and Education	0.1542**	0.0146	-0.0302	0.0553	-0.1385*	0.0671	0.1731 ⁺	0.0859	0.0502	0.0537	0.1849	0.1211
Expenditure on Extension	-	-	-0.0370	0.0547	-0.1056	0.0606	0.1802 ⁺	0.0881	-	-	0.1758	0.1177
Per Capita AgNSDP	0.1500**	0.0142	-0.0178	0.0567	-0.1076	0.0682	0.2741**	0.0871	0.0341	0.0534	0.0859	0.1229
Coefficient of multiple determination (R ²)	0.82**		0.25*		0.53**		0.48**		0.68**		0.18 ⁺	

Notes: Blank cells indicate not potential indicators for the states.

** , * and ⁺ indicate statistical significance at 1, 5 and 10 per cent level respectively.

Continued

Table 4.28. Standardized estimates of agricultural development indicators for the major states and all India (continued)

Indicators	Jammu & Kashmir		Karnataka		Kerala		Madhya Pradesh		Maharashtra		Orissa	
	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error
Cropping Intensity	0.2306*	0.0253	0.0923	0.0640	-	-	0.1925**	0.0160	0.2304**	0.0307	0.0381*	0.0206
Irrigation Intensity	-	-	-	-	-	-	-	-	-	-	-	-
Net Irrigated Area	-	-	0.1104	0.0652	-0.2948**	0.0587	0.2000**	0.0166	0.2427**	0.0324	0.0408*	0.0221
Area under HYVs	0.2013**	0.0221	0.2319**	0.0644	-	-	0.1970**	0.0163	0.2478**	0.0331	0.0428*	0.0232
Fertilizer Consumption	0.2250**	0.0247	0.0496	0.0654	-0.3949**	0.0698	0.1956**	0.0162	0.2469**	0.0329	0.0417*	0.0226
Foodgrain Productivity	-	-	-	-	-0.2364**	0.0601	0.1891**	0.0157	0.2104**	0.0281	-	-
Agricultural Workers	0.2364**	0.0259	0.0756	0.0636	-0.0047	0.0561	0.1837**	0.0153	0.2455**	0.0328	-	-
Livestock Density	0.2414**	0.0265	-	-	0.0107	0.0750	-	-	0.2365**	0.0315	-	-
Pumpset	0.2336**	0.0256	0.1057	0.0661	-0.3097**	0.0595	0.2005**	0.0166	0.2397**	0.0320	0.0427*	0.0231
Tractor	0.2206**	0.0242	0.0468	0.0663	-0.4489**	0.0745	0.1998**	0.0166	0.2473**	0.0330	-	-
Regulated Market	-	-	0.0637	0.0655	-	-	0.1948**	0.0162	0.2456**	0.0328	0.0411*	0.0223
Electrified Villages	0.2281**	0.0250	-0.0801	0.0659	-0.2896**	0.0542	0.1962**	0.0163	0.2398**	0.0320	0.0425*	0.0230
Electricity Consumption in Agriculture	-	-	0.1579*	0.0633	-	-	0.1884**	0.0156	0.2519**	0.0336	0.0403*	0.0219
Density of Rural Roads	-	-	0.0864	0.0659	-0.2155**	0.0595	0.1962**	0.0163	0.2254**	0.0301	0.0421*	0.0228
Rural Literacy	0.2425**	0.0266	0.1041	0.0663	-0.1808**	0.0599	0.2004**	0.0166	-	-	0.0427*	0.0231
Net Value of Agricultural Production	0.2223**	0.0244	0.3219**	0.0662	-0.0120	0.0587	0.1955**	0.0162	0.2386**	0.0318	0.0396*	0.0215
Expenditure on Agricultural Research and Education	0.2094**	0.0230	0.3009**	0.0661	-0.0696	0.0582	0.1884**	0.0156	0.2469**	0.0329	0.0393*	0.0213
Expenditure on Extension	0.2235*	0.0245	0.1814*	0.0642	-	-	-	-	0.2368**	0.0316	-	-
Per Capita AgNSDP	0.2282**	0.0250	0.3171**	0.0662	-0.0266	0.0581	0.1957**	0.0162	0.2405**	0.0321	0.0408*	0.0221
Coefficient of multiple determination (R ²)	0.77**		0.80**		0.83**		0.85**		0.69**		0.12*	

Continued

Table 4.28. Standardized estimates of agricultural development indicators for the major states and all India (continued)

Indicators	Punjab		Rajasthan		Tamil Nadu		Uttar Pradesh		West Bengal		All India	
	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error	coefficient	Standard error
Cropping Intensity	0.1540+	0.0763	0.1017	0.0724	-	-	0.2934**	0.0545	0.3054**	0.0562	0.1042**	0.0150
Irrigation Intensity	0.2469**	0.0747	-	-	-	-	0.1920**	0.0546	-	-	0.1013**	0.0146
Net Irrigated Area	0.1793*	0.0747	0.0485	0.0755	-	-	0.2579**	0.0555	0.7149**	0.0583	0.1049**	0.0152
Area under HYVs	0.5085**	0.0756	0.3160**	0.0935	0.0647	0.0746	0.2606**	0.0548	0.2545**	0.0593	0.1031**	0.0149
Fertilizer Consumption	0.3582**	0.0747	-0.1471	0.0866	0.0997	0.0756	0.2487**	0.0555	0.3984**	0.0606	0.1038**	0.0150
Foodgrain Productivity	0.1231	0.0759	-	-	0.2249*	0.0773	0.2113**	0.0550	0.2050**	0.0580	0.1032**	0.0149
Agricultural Workers	-	-	0.2748**	0.0849	-0.0295	0.0744	0.1644*	0.0556	0.4271**	0.0579	0.1042**	0.0151
Livestock Density	-	-	-	-	-	-	0.2008**	0.0553	-	-	0.0992**	0.0143
Pumpset	0.2757**	0.0746	0.1366	0.0825	-0.1418	0.0713	0.2078**	0.0563	0.3049**	0.0610	0.1031**	0.0149
Tractor	-0.2220*	0.0755	0.0074	0.0806	0.1452	0.0782	0.1842**	0.0563	0.3512**	0.0603	0.1042**	0.0150
Regulated Market	0.3154**	0.0725	0.3938**	0.1030	-0.2530**	0.0779	-	-	0.4062**	0.0583	0.1006**	0.0145
Electrified Villages	0.5972**	0.0731	-0.2963*	0.1002	-0.1604†	0.0770	0.2195**	0.0557	0.4697**	0.0603	0.1033**	0.0149
Electricity Consumption in Agriculture	0.2690**	0.0711	-	-	-	-	0.2568**	0.0496	-0.0938	0.0605	0.1041**	0.0150
Density of Rural Roads	0.1632*	0.0766	0.0771	0.0802	-0.0264	0.0766	0.2619**	0.0556	0.3400**	0.0607	0.1029**	0.0149
Rural Literacy	0.0015	0.0767	0.0022	0.0809	0.1257	0.0792	0.0987	0.0562	0.0761	0.0610	0.1045**	0.0151
Net Value of Agricultural Production	-0.3206**	0.0762	-0.2318*	0.0944	0.3838**	0.0748	0.0693	0.0560	-0.0359	0.0608	0.0972**	0.0140
Expenditure on Agricultural Research and Education	-0.2353**	0.0751	-0.1660†	0.0880	0.5096**	0.0701	0.0586	0.0548	0.1399*	0.0603	0.1018**	0.0147
Expenditure on Extension	-	-	-	-	0.3073**	0.0756	-0.0005	0.0553	0.7751**	0.0587	0.1023**	0.0148
Per Capita AgNSDP	-0.3016**	0.0763	-0.2662*	0.0978	0.3056**	0.0748	0.0832	0.0561	-0.0326	0.0608	0.0992**	0.0143
Coefficient of multiple determination (R ²)	0.59**		0.40**		0.53**		0.90**		0.94**		0.66**	

Orissa

Basically, agriculture is related with so many factors, such as, natural, physical and environmental factors, etc. If all the factors are not favorable for agriculture it will not produce significant development in this sector. In this regard, Orissa had been affected by few natural calamities, which disfavored the agricultural development. It had been found that all the potential indicators showed positive coefficients and significant at 10 per cent level though the coefficient of multiple determination (R^2) was 0.12 that is also significant at 10 per cent level (Table 4.27). It indicates the goodness of fit of this model was not well to explain the total variation. However, the potential factors were mostly at similar level and positively related with agricultural development. It might be due to other factors, which were not included in the model or changes of the indicators over the time periods were not sufficient to capture the agricultural development in the state. Since, the positive and significant contribution of the potential indicators to be increased through the proper management of these factors. It could enhance the agricultural development of the state and might reduce the disparities across the states.

Punjab

Punjab is a developed state though all potential factors did not equally contribute to agricultural development. Out of 16 potential indicators, the coefficients of 12 indicators have shown positive and 4 have shown negative coefficients, however, 10 positive coefficients and all negative coefficients were significant at the different levels of significance (Table 4.27). The coefficient of multiple determination (R^2) was 0.59, which was significant at one per cent

level. It implies that all indicators had not contributed evenly on the agricultural development of the state. Therefore, the proper combination of all indicators might capture the full potential of agricultural development of the state.

Rajasthan

In Rajasthan, out of 14 potential indicators, 9 indicators had positive and 5 indicators had negative coefficients, while 3 positive and 4 negative coefficients were statistically significant at the different levels of significance (Table 4.27). The coefficient of multiple determination (R^2) was 0.40, which was significant at 5 per cent level. It implies that the potential indicators virtually had not contributed to the advancement of the state from backward to forward over the time periods. Hence, it is needed to improve the contribution from all potential factors in the state.

Tamil Nadu

Tamil Nadu as an agriculturally developed state though could not proceed faster due to lack of proper contribution by the development indicators. It had been found that the out of 14 potential indicators, 9 were positive and 5 were negative coefficients, however 5 positive and 2 negative coefficients were significant at the different levels of significance (Table 4.27). The coefficient of multiple determination (R^2) was 0.53 which is significant at 1 per cent level. Though, all the factors are so important for agricultural development but the changes of the indicators over the time periods were not consistent and these were inadequate to support the agricultural development of the state. It implies that the agricultural development to be enhanced through the combined and significant contribution from all potential factors.

Uttar Pradesh

Uttar Pradesh as a largest state has always played an important role especially in the agricultural development of the country. The lack of proper distribution of potential resources is a barrier for the development of a state. However, out of 18 potential indicators, 17 indicators had positive coefficients except expenditure on extension, though 13 positive coefficients were significant at 1 per cent and 5 per cent levels and the single negative coefficient of expenditure on extension was not significant (Table 4.27). The coefficient of multiple determination (R^2) was 0.90, which was significant at 1 per cent level. It implies that most of the indicators except a few indicators had contributed to the development of agriculture in the state. Moreover, the state has shown slower converging trend of development which might increase with the proper combination of all factors.

West Bengal

In West Bengal, out of 17 potential indicators, coefficients of 14 indicators had been found positive and 3 negative, while one positive and all 3 negative coefficients were not statistically significant (Table 4.27). The coefficient of multiple determination (R^2) was 0.94, which was also significant at 1 per cent level. It reveals that most of the indicators were positively and significantly contributing to the agricultural development, as a result, the state is substantially put forward in agricultural development over the period. Proper linkages among the indicators are further needed for accelerated development of agriculture sector, which is their mainstay of economy.

All India

In overall all India situation of agriculture is escalating chronologically which has stipulated the development of other sectors. Although there is ample option for the development of agriculture by reducing the inter-state disparities and increasing the potentiality of less developed states through proper management of resources and policy implications. It had been found that the estimated coefficients of all included potential indicators were positive and significant at the 1 per cent level and coefficient of multiple determination (R^2) was 0.66, which was also significant at 1 per cent level (Table 4.27). The standardized coefficients had shown mostly similar impact by all the indicators. It implies that the country has moved ahead gradually in agriculture by the combined contribution of agricultural, infrastructural and socio-economic factors. However, there is need to minimize the inequity, reduce the uneven distribution of resources and remove the disparities level across the states to promote balanced development of the country.

It has been exposed by the PCR estimation of the individual states and all India that all the potential indicators had not contributed significantly, though it was expected for the balanced development of agriculture in the state. Despite of the fact, the potential indicators had considerably and positively contributed to the agricultural development in Andhra Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal and all India whereas mixed impact was observed in the state of Bihar, Gujarat, Haryana, Punjab, Rajasthan and Tamil Nadu and negatively contributed in the state of Assam, Himachal Pradesh and Kerala. Moreover, Orissa's scenario was

completely different from the other states as all the estimated coefficients were positive and significant at 10 per cent level but considerably were low in comparison to other states. Hence, it is needed to increase the potentiality of all indicators, which were not significant and positively contribute in the development process. Moreover, it is required to reduce the existence of large disparities among the indicators across the states for balanced development in the country.

The variation in agricultural development was largely due to differences in potential factors and its contribution on agricultural development. However, only these indicators are not exhaustively responsible for agricultural development due to its biological nature and dependency on climatic factors. But, the potentiality and contribution of these factors on agricultural development are major accountable for imbalanced development across the states. Since, it had been identified the potential factors and its contribution on agricultural development as state-wise. The results are summarized in Table 4.28, which reveals the potential positive contributing major factors for agricultural development in the states and all India. It was found that the net irrigated area, area under HYVs, fertilizer consumption, pumpset, regulated market, electrified villages, electricity consumption in agriculture, density of rural roads, expenditure on agricultural research and education and per capita AgNSDP were significant positive contribution on agricultural development in most of the states. However, the contributing factors varied state to state.

Table 4.28 Potential positive contributing major factors for agricultural development in the states and all India

States	Agricultural development indicators									
	Cropping Intensity	Irrigation Intensity	Net Irrigated Area	Area under HYVs	Fertilizer Consumption	Foodgrain Productivity	Agricultural workers	Livestock Density	Pumpset	Tractor
Andhra Pradesh	-	-	P	P	P	P	P	-	P	P
Assam	Not a single indicator had shown positive significant contribution though showed their potentiality									
Bihar	-	-	-	P	-	-	-	-	-	P
Gujarat	-	-	P	-	P	-	-	-	-	-
Haryana	P	-	P	P	P	P	P	P	P	-
Himachal Pradesh	Not a single indicator had shown significant contribution though a few indicators showed positive coefficient and showed their potentiality.									
Jammu and Kashmir	P	-	-	P	P	-	P	P	P	P
Karnataka	-	-	-	P	-	-	-	-	-	-
Kerala	Not a single indicator had shown positive significant contribution though half of the indicators showed their potentiality.									
Madhya Pradesh	P	-	P	P	P	P	P	-	P	P
Maharashtra	P	-	P	P	P	P	P	P	P	P
Orissa	P	-	P	P	-	-	-	-	P	-
Punjab	P	P	P	P	P	-	-	-	P	-
Rajasthan	P	-	-	P	-	-	P	-	-	-
Tamil Nadu	-	-	-	-	P	P	-	-	-	-
Uttar Pradesh	P	P	P	P	P	P	P	P	P	P
West Bengal	P	-	P	P	P	P	P	-	P	P
All India	P	P	P	P	P	P	P	P	P	P

Note: P – indicates potential positive contributing factors.

Continued.....

There was not found a single significant positive contributing factor in Assam, Himachal Pradesh and Kerala. As a result, these states showed the diverging trend in CADIs during the study period. Hence, the contribution of all the indicators as positive factors of agricultural development is needed to promote the balanced development. But, the indicators are not reached at the critical minimum level for influencing to agricultural development. Since, it is required proper policy and priority for increasing the level of indicators for effective positive contribute to agricultural development.

4.3.2 Assessment of Overall Impacts of the Indicators on Agricultural Development

In order to examine the impact of the indicators on agricultural development across the states, a Cobb-Douglas type of function has been proposed based on cross-section and time-series data. The Cobb-Douglas form of function has some well-known properties that justify its wide application in economic literature (Henderson and Quandt, 1971). In the Cobb-Douglas function, 17 major states and all India have been considered as dummy variables to capture the state or regional effects in the model for the study period.

The estimated coefficients of the different independent indicators and dummy intercepts, the standard errors, t-statistics, probability level of significance and the coefficient of multiple determination (R^2) are presented in Table 4.29. The model is a good fit as about 98 per cent of the variations in the CADIs have been explained by the chosen specification.

Among the indicators of agricultural development, the elasticity of coefficients had been found 14 positive and 8 negative, however 11 positive and 2 negative coefficients were significant at 1 per cent level, 1 negative coefficient was significant at 5 per cent level and 1 positive and 2 negative coefficients were significant at 10 per cent level of significance.

Table 4.29 Estimated coefficients of the agricultural development indicators by using the Cobb-Douglas function with state dummy

Variables	Estimated coefficients	Standard error	t statistic	Probability of significance
Cropping Intensity	-0.1900 ⁺	0.116	-1.64	0.10
Irrigation Intensity	0.1620**	0.047	3.43	0.00
Net Sown Area	0.0175	0.023	0.76	0.45
Net Irrigated Area	0.1280**	0.029	4.49	0.00
Area under HYVs	0.0739**	0.013	5.75	0.00
Fertilizer Consumption	-0.0234	0.015	-1.55	0.12
Foodgrain Productivity	0.1550**	0.024	6.43	0.00
Agricultural Workers	-0.0709	0.079	-0.89	0.37
Livestock Density	0.1480**	0.035	4.25	0.00
Pumpset	-0.0257**	0.007	-3.91	0.00
Tractor	0.0805**	0.011	7.34	0.00
Regulated Market	-0.0378**	0.010	-3.72	0.00
Electrified Villages	0.0803**	0.012	6.62	0.00
Electricity Consumption in Agriculture	0.0522**	0.009	6.07	0.00
Density of Rural Roads	-0.0429 ⁺	0.023	-1.86	0.06
Primary Agricultural Cooperative Society	0.0111	0.011	1.01	0.32
Rural Literacy	-0.0641	0.046	-1.38	0.17
Net Value of Agricultural Production	-0.2170*	0.092	-2.36	0.02
Expenditure on Agricultural Research and Education	0.0299**	0.007	4.33	0.00
Expenditure on Extension	0.0246**	0.003	7.80	0.00
Share of AgNSDP	0.2870**	0.028	10.41	0.00
Per Capita AgNSDP	0.1680 ⁺	0.096	1.75	0.08

Continued

Note: **, * and ⁺ indicate statistical significance at 1, 5, and 10 per cent level respectively.

Table 4.29 Estimated coefficients of the agricultural development indicators by using the Cobb-Douglas function with state dummy (continued)

Variables	Estimated coefficients	Standard error	t statistic	Probability of significance
Andhra Pradesh	0.1640**	0.030	5.39	0.00
Assam	0.0687	0.071	0.97	0.34
Bihar	0.3890**	0.064	6.06	0.00
Gujarat	0.0404	0.033	1.21	0.23
Haryana	0.1640**	0.052	3.14	0.00
Himachal Pradesh	0.2690**	0.072	3.75	0.00
Jammu and Kashmir	-0.1110	0.073	-1.52	0.13
Karnataka	0.0290	0.028	1.04	0.30
Kerala	0.6800**	0.100	6.82	0.00
Madhya Pradesh	-0.5420**	0.038	-14.27	0.00
Maharashtra	0.2490**	0.038	6.62	0.00
Orissa	-0.0454	0.040	-1.13	0.26
Punjab	0.3680**	0.058	6.38	0.00
Rajasthan	-0.6450**	0.055	-11.76	0.00
Tamil Nadu	0.5610**	0.051	10.90	0.00
Uttar Pradesh	0.0270	0.048	0.56	0.57
West Bengal	0.7000**	0.081	8.61	0.00
All India (constant)	0.6810	0.744	0.92	0.36
Coefficient of multiple determination (R ²)			0.982**	

Note: **, * and + indicate statistical significance at 1, 5, and 10 per cent level respectively.

Among the dummy variables of the states, only 4 coefficients of state's dummy were negative, these were of Jammu and Kashmir, Madhya Pradesh, Orissa and Rajasthan, though in case of Jammu and Kashmir and Orissa were not significant, and other 2 states Madhya Pradesh and Rajasthan were significant at 1 per cent level. In other 13 states and all India dummy coefficients had been found positive but were not significant for Assam,

Gujarat, Karnataka, Uttar Pradesh and all India, though in rest of the states dummy coefficients were significant at 1 per cent level. These coefficients have been taking all India as base. Significant coefficients for the dummy variables for the states in the model provide a very strong support for analysis using state level data. It seems that the growth of the indicators over the time periods were not consistent in contributing positively on agricultural development across the states as well as all India. The changes of the indicators had reasonably contributed in nine states.

Table 4.29 shows that the most influencing indicators was share of AgNSDP which had the highest estimated coefficient (0.2870) followed by per capita AgNSDP (0.1680), irrigation intensity (0.1620), foodgrain productivity (0.1550), livestock density (0.1480), net irrigated area (0.1280), tractors (0.0805), electrified villages (0.0803), area under HYVs (0.0739), expenditure on agricultural research and education (0.0299) and expenditure on extension (0.0246), these were significant and positive contributory indicators on agricultural development. Among the significant and negative influencing indicators on agricultural development were net value of agricultural production (-0.2170) followed by cropping intensity (-0.1900), density of rural roads (-0.0429), regulated market (-0.0378) and pumpset (-0.0257). Moreover, the important indicators such as fertilizer consumption and literacy rate have surprisingly shown negative coefficients though these were not significant. It is evident that the negative coefficients of the indicators do not appear to have any significant impacts on agricultural development, probably because these have not reached that critical minimum level in few states where these indicators may

start influencing the process of development in agriculture. This analysis reveals that the wide variations among the indicators across the states have not enabled to advocate the balanced development efforts throughout the country. For balanced development of the states and reduce the disparities across the states development of all the indicators is important.

4.4 Emerging Policy Issues for Balanced Agricultural Development

The findings of this macro study provide some important implications for the agricultural development policy of India. However, these should be considered in the light of the limitations of the study and be used to enunciate broad guidelines rather than precise magnitude of the policy variables.

The Government of India in its Five Year Plans have laid down the objectives of balanced development and reduction in disparities. But, the study revealed that there have been considerable inter-state disparities in the level of agricultural development. Obviously, the differences in natural and physical factors account for the disparities. However, the disparities have also increased due to the variation in agricultural, infrastructural and socio-economic factors. Moreover, the richer states have faster agricultural growth while poorer states have poorer agricultural growth due to variation in resource endowments and unequal distribution of resources across the states. Since, the findings of the study have several policy implications for balanced agricultural development of the country. For minimizing the inter-state disparities and to promote the balanced agricultural development, the resources should be distributed on the basis of equity, efficiency, productivity and sustainability.

Accelerating Agricultural Development with Equity

In the equity concern, developing and less developed states should be given special priority to bridge-up the immense development disparities across the states by the proper agricultural policy. The policy option ought to be taken care of infrastructural and modern agricultural inputs facilities of developing and less developed states, which could not afford the sufficient and positive contribution in comparison to developed and moderately developed states due to large variation among the indicators. Apparently, big push is needed to close-up the disparities amongst the developed, moderately developed, developing and less developed states. In this regard, special direction is provided by the findings of this study.

Improving the Potentiality and Efficiency of the Indicators

The growth of some of the indicators has not given significant result to mobilize the pace of development. But, significant change of the indicators is urgently needed to increase the efficiency of the indicators and enhance continuous development of the state. The potential indicators and contribution of the indicators have been identified state-wise that gives the clear message which indicator is needed special emphasis to improve its efficiency. Though the contribution of the indicators widely varied from state to state, but special attention is required to improve efficiency of the indicators in case of Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Kerala, Madhya Pradesh, Orissa and Rajasthan and Uttar Pradesh.

Increasing Productivity of the Indicators

Agricultural development has been quantified by the composite indices of agricultural development based on optimum combination of multiple indicators. Since, potentialities of the indicators have to be increased by augmenting the productivity through maximized co-integration effects of the indicators for minimizing the disparities and balanced development for all the states and all India. The level of indicators has not reached at the critical minimum level for significantly contributing to agricultural development in a few states. For this purpose low index based states desired specific policy strategies to improve their productivity through increase the level of indicators.

Incentives for Sustaining Balanced Agricultural Development

To promote the balanced agricultural development of the states, government intervention is required for build-up the infrastructural facilities and to provide the modern agricultural technologies at farmers level. Since, in the less developed and developing states government intervention should be oriented infrastructure development, assure modern inputs supply and ensure price of the agricultural commodities. Furthermore, in developed and moderately developed states the existing facilities should be ensured for proper functioning in the state development process, which have shown decelerating performance in agricultural development. The recent slowdown in agricultural development is needed to protect for sustaining balanced agricultural development across the states. In these aspects appropriate policy to be formulated at the state level and national level for agricultural development.

Hence, there are clear indications could be profound for balanced agricultural development in the states. First, it needs to give a big push in the developing and less developed states to reduce the level of disparities in agricultural development. This can happen only if there is larger devolution of resources to the states for agricultural development. Second, there are ample evidences that the developing and less developed states have greater scope to enhance their productivity by the proper strategic policy implementation. Therefore, the contribution of potential indicators should be enforced through public investment in agricultural development in the less developed states. Third, it is time to have a serious thinking on balanced agricultural development across the states. The government, so far, implement and execute the state level agricultural policy according to their status of agricultural development. Finally, the achievements of agricultural development should be continued and deceleration effect to be stopped in the states. It needs to find out proper causes for deceleration effect and to develop the specific strategic policy for agricultural development. The results of this study clearly show the dimension of agricultural development and policy implications to promote balanced development in the country.

CHAPTER V

SUMMARY AND CONCLUSIONS

In an agrarian economy like India, agriculture has played an important role in the economic development. It is the largest and most important sector of the Indian economy. Even after five decades of planning and industrial development, about one-fourth of national income comes from agriculture and more than 60 per cent of working population is engaged in this sector. Agriculture, as a matter of fact, forms the backbone of the economy, and despite the concerted industrialization during the plan periods, agriculture still occupies predominant position in the development process of the economy. India has taken rapid strides in bringing improvement in agriculture sector. However, it is often alleged that all the states in India have not witnessed a uniform economic growth in agricultural development. It is not due to any policy neglect but have arisen out of the inherent differences in resource endowments in various states and the extent to which potential resources are being utilized. Thus, resource difference and their potential utilization have led to inter-state disparities in agricultural development among the states. The determination of these disparities in agricultural development across the states is crucial to identify the extent of inter-state disparities and the factors associated with it, for planners and policy makers. This study is an attempt in this direction. The findings of the study will provide useful information for initiating specific strategies and proper policy actions for balanced agricultural development in the country. The specific objectives of the present study are:

1. To examine the temporal and spatial disparities in agricultural development across the states;
2. To identify the potential factors of agricultural development in various states;
3. To assess the contribution of the potential factors of agricultural development across the states;
4. To suggest policy measures to minimize the inter-state disparities and promote balanced agricultural development in country.

The analysis of inter-state disparities in agricultural development and the factors of development involve multiple variables, and falls in the domain of multivariate analysis. In view of this, twenty-two variables were selected as the agricultural development indicators those were related with agricultural, infrastructural and socio-economic factors. The data of the indicators have been collected for 17 major states and all India from 1970-71 to 1996-97 from various published secondary sources.

In order to examine, the inter-state disparities in agricultural development across the states and over the time periods composite agricultural development indices (CADIs) have been constructed based on the 22 indicators of agricultural development and the triennium central average data was considered for the analysis as a weighted approach. Furthermore, the states have been ranked on the basis of indices and the states are classified in developed, moderately developed, developing and less-developed categories by using the Beta distribution for five years interval periods.

The Principal Component Analysis (PCA) has been used to identify the most potential factors of agricultural development in various states. The

contribution of the potential indicators was assessed by employing the Principal Component Regression (PCR) and overall impact of the indicators and state's effect have been estimated through Cobb-Douglas type of function with intercept states dummy.

The CADIs of the major states and all India clearly portrays the spatio-temporal disparities of agricultural development across the states. The indices of agricultural development of major states had shown an increasing trend except in two states, Assam and Kerala where the index showed the declining trend during the period 1971-72 to 1995-96. However, most of the states could not maintain smooth progress of agricultural development. Andhra Pradesh, Maharashtra, Uttar Pradesh, West Bengal and India always showed the positive trends of agricultural development. In the period 1971-72 to 1975-76, Assam, Gujarat, Madhya Pradesh and Orissa recorded decline in CADIs, and in other states there was improvement. In the following period, Gujarat and Orissa improved their indices though Assam and Madhya Pradesh had gone down further. In comparison to previous period in 1985-86, Himachal Pradesh recorded sharp decline in its indices, whereas Kerala and Punjab recorded marginal decline. However, Himachal Pradesh and Punjab improved in terms of CADIs again in the next period 1990-91, but Kerala had shown continuously declining trend up to 1995-96. It is also revealed that Bihar and Rajasthan had shown declining trend in 1990-91 that continued till 1995-96 and after 1990-91 the highly developed states like Haryana and Punjab also recorded decline their indices of agricultural development. It was observed that Assam had continuously falling in terms of CADIs. The main reasons for the extreme

position of Assam are its inadequate infrastructure, the various problems in the sphere of agriculture, inadequate credit and storage facilities.

There emerged a very typical picture when agricultural development indices (from 1971-72 to 1995-96) of all India were compared with other major states. All-northern region states i.e., Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab and Uttar Pradesh were always above all India in agricultural development from the very beginning. In case of all-southern region states i.e., Andhra Pradesh, Kerala, and Tamil Nadu were also above all India except Karnataka. While the eastern region states, Bihar and West Bengal were above and Assam and Orissa were below all India. Besides, the western region states i.e., Gujarat, Madhya Pradesh, Maharashtra and Rajasthan were always far behind all India since 1971-72. It is inferred from this that northern and southern states were mostly developed, eastern states were moderately developed and western states were very less developed in comparison to all India in agricultural development.

On the other hand, temporal situation was very discriminating where large variations existed across the states. The highest index of Punjab was 67.30 whereas the lowest was 13.15 of Madhya Pradesh and the coefficient of variation of the indices was 43.36 percent in 1971-72. Punjab was always holding the highest indices and Madhya Pradesh was holding the lowest indices except the period of 1995-96 where the lowest indices were taken by Rajasthan. The declining coefficient of variations is considered as narrowing the regional disparities. The coefficient of variation of indices was 43.36 per cent in 1971-72 and 37.43 percent in 1995-96. It indicates a convergent trend in the inter-state

levels of agricultural development. Thus, it may be inferred that the strategy of agricultural development had played positive role in reducing the incidence of inter-state disparities during the study period.

In comparison to beginning and ending period, the states had changed their relative position according to their indices of agricultural development, at different time periods except Punjab, Haryana, and Tamil Nadu, these states always hold first, second and third position respectively. West Bengal, Uttar Pradesh, Andhra Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, and Maharashtra had convergent trend in agricultural development whereas Assam, Bihar, Gujarat, Himachal Pradesh, Kerala, Orissa, and Rajasthan had divergent trend but all India mostly hold the same position with convergent trend.

The states were classified into four categories based on stages of agricultural development using Beta distribution. Punjab, Haryana and Tamil Nadu belonged to the developed group throughout the time period, however in 1990-91, Tamil Nadu had gone down in moderately developed group. Madhya Pradesh, Orissa, and Rajasthan fall in the less developed group. While Gujarat, Karnataka and Maharashtra and all India were in the developing group, however, Maharashtra was in a less developed group in the initial year (1971-72). Andhra Pradesh and Uttar Pradesh belonged to the moderately developed group in the initial period and had gone down in the developing group from the period 1975-76 onwards. However, Uttar Pradesh came up again in the moderately developed group in the period 1985-86 and Andhra Pradesh in 1990-91 onwards. On the other hand, two states moved in opposite direction of development, namely, Jammu & Kashmir and Assam. Over the time, Jammu &

Kashmir had come up from developing group to moderately developed group and Assam had gone down developing group to less developed group. Since, several states changed their relative ranking position but the stages of agricultural development remained same in throughout the study period. Thus, it seems that the agricultural development took place all the states, but it was not reached up to that level for changing the stages of agricultural development and unevenly distributed across the states over the time period.

The indicators were not evenly distributed across the states as well as over the time period within states, which indicate heterogeneous distribution among the indicators. Due to this heterogeneous distribution of the indicators, the potential factors of agricultural development were quite different from state to state. However, out of 22 indicators, most of the indicators were shown as potential indicators in the state except the net sown area, primary agricultural cooperative society and share of AgNSDP.

It had been shown by the PCR estimates of individual states and all India that all the potential indicators had not contributed significantly, though it was expected for the balanced development of agriculture in the state. However, the potential indicators had positively contributed in agricultural development in the state of Andhra Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal and all India whereas mixed impact was shown in the state of Bihar, Gujarat, Haryana, Punjab, Rajasthan and Tamil Nadu and have negatively contributed in the states of Assam, Himachal Pradesh and Kerala. Moreover, Orissa was completely different from the other states as

because all the estimated coefficients were positive and significant at 10 per cent level but considerably were low in comparison to other states.

By using the Cobb-Douglas type of function with states' intercept dummy, it was observed that among the indicators of agricultural development, the significant and positive contributing factors were irrigation intensity, net irrigated area, area under HYVs, foodgrain productivity, tractor, livestock density, electrified villages, expenditure on agricultural research and education and expenditure on extension, share of AgNSDP and per capita AgNSDP. However, the variations of the indicators across the states were quite high, as a result, the agricultural development significantly and positively changed in the states of Andhra Pradesh, Bihar, Haryana, Himachal Pradesh, Kerala, Maharashtra, Punjab, Tamil Nadu and West Bengal.

The existence of wide variations among the indicators across the states was unable to advocate the balanced development throughout the country. Thus, these variations are both cause and effect of agricultural development across the states. Hence, it is needed to increase the potentiality of all indicators, which were not significantly and positively contributing in the development process. Moreover, it is required to incorporate all indicators sufficiently and judiciously for balanced development of all the states and reduce the disparities across the states.

The conclusions for policy can be drawn from the findings of this study for balanced agricultural development across the states and all India. The main objective of national policy is balanced development of the states but still presents a picture of uneven development. Indeed agricultural development has

great impact to alleviating poverty, income generation, employment and after all food security to the livelihood people. Since, it requires minimizing the disparities level of agricultural development by larger devolution of resources to the states. So, the agricultural development is to be accelerated with equity. The potential factors and its contribution varied state to state. But, the significant contribution is needed by all factors as positive factors of agricultural development. Hence, it requires improving their efficiency and productivity whenever it is needed. As a matter of great concern, the disparities level of agricultural development ought to be taken care in national agricultural policy and formulate the state and national level agricultural policy.

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Appendix 1. Agricultural development indices and coefficient of variations of the indices of the Major states and all India from 1971-72 to 1995-96

States	Composite Agricultural Development Index (%)								
	1971 -72	1972 -73	1973 -74	1974 -75	1975 -76	1976 -77	1977 -78	1978 -79	1979 -80
Andhara Pradesh	31.17	31.63	32.49	32.97	31.30	30.69	30.78	31.33	31.71
Assam	27.26	26.59	26.24	25.23	25.77	25.89	27.02	27.14	26.28
Bihar	34.01	34.25	33.61	33.66	34.40	35.28	35.77	35.46	36.18
Gujarat	26.90	26.00	24.43	22.11	23.79	25.73	26.56	27.18	27.52
Haryana	53.99	53.30	53.26	53.78	55.04	55.21	55.83	54.83	55.38
Himachal Pradesh	39.47	39.00	39.57	41.24	41.75	40.79	40.41	40.16	39.59
Jammu and Kashmir	28.58	28.66	28.45	29.44	29.42	30.55	31.59	32.36	31.68
Karnataka	23.32	23.11	23.98	25.01	25.88	25.40	24.72	24.58	24.66
Kerala	42.66	42.06	41.12	40.42	39.95	40.68	41.54	40.94	41.10
Madhya Pradesh	13.15	13.36	13.12	13.00	12.78	12.83	12.72	11.83	11.40
Maharashtra	15.32	15.29	16.72	19.51	22.91	23.68	24.40	24.66	25.23
Orissa	21.05	21.02	20.74	20.41	19.80	20.85	21.94	22.86	22.28
Punjab	67.30	69.01	70.39	72.41	73.36	75.50	76.54	75.71	73.83
Rajasthan	16.70	16.12	16.08	16.55	18.27	18.77	20.86	22.14	21.77
Tamil Nadu	46.86	46.84	45.68	45.87	46.74	47.58	47.69	47.13	46.68
Uttar Pradesh	31.22	31.16	31.27	31.05	31.49	32.63	33.20	32.38	32.83
West Bengal	31.03	30.15	29.23	30.22	32.23	33.00	33.19	34.66	35.52
All India	26.56	26.32	26.47	27.38	29.05	29.99	30.56	30.46	30.56
Coefficient of Variations	43.36	44.29	44.65	44.97	43.82	43.62	42.90	41.85	41.32

Appendix 1. Agricultural development indices and coefficient of variations of the indices of the Major states and all India from 1971-72 to 1995-96 (continued)

States	Composite Agricultural Development Index (%)							
	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88
Andhara Pradesh	32.84	33.13	32.86	32.44	32.37	32.84	32.39	33.55
Assam	25.55	25.13	24.50	24.35	24.39	26.03	26.16	25.65
Bihar	36.05	36.42	35.30	36.04	37.29	39.14	38.97	38.18
Gujarat	29.73	30.04	30.44	29.71	28.73	27.73	26.28	28.61
Haryana	56.10	57.13	56.55	55.51	56.08	56.73	56.77	56.91
Himachal Pradesh	39.27	38.27	36.93	35.24	35.35	35.91	36.56	37.87
Jammu and Kashmir	32.03	32.74	32.62	32.86	34.19	36.20	36.52	36.83
Karnataka	25.50	25.10	24.60	24.25	24.57	25.81	25.85	26.68
Kerala	40.97	40.36	39.52	38.62	39.09	39.77	39.40	38.01
Madhya Pradesh	11.58	12.43	12.53	12.46	13.27	13.85	14.68	15.30
Maharashtra	25.94	25.77	26.43	26.45	27.35	27.14	27.53	26.63
Orissa	22.05	21.92	21.97	21.47	22.41	22.93	22.98	22.04
Punjab	74.85	75.14	74.82	73.37	73.64	74.01	74.16	73.67
Rajasthan	22.52	22.77	22.62	21.67	20.89	20.11	19.39	19.16
Tamil Nadu	47.88	47.93	47.47	46.37	47.27	47.97	46.35	45.46
Uttar Pradesh	33.46	34.34	33.83	33.53	34.61	35.88	36.12	36.71
West Bengal	35.90	35.82	36.41	36.91	38.30	38.94	39.52	40.86
All India	31.13	31.53	31.18	30.64	30.81	31.16	31.03	31.23
Coefficient of variations	41.10	41.06	40.98	40.69	40.35	39.88	39.85	39.25

Appendix 1. Agricultural development indices and coefficient of variations of the indices of the Major states and all India from 1971-72 to 1995-96 (continued)

States	Composite Agricultural Development Index (%)							
	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Andhara Pradesh	34.45	36.03	35.98	35.80	36.10	36.66	37.31	37.24
Assam	24.65	25.26	25.38	25.28	25.13	24.83	24.94	24.03
Bihar	36.37	36.89	36.35	35.93	35.99	36.36	36.24	36.19
Gujarat	29.40	31.07	29.85	29.95	29.54	30.08	30.10	30.45
Haryana	57.03	59.00	59.48	59.70	59.33	58.93	58.29	58.18
Himachal Pradesh	38.69	40.24	40.56	39.68	38.74	37.45	37.55	36.93
Jammu and Kashmir	35.93	36.64	35.17	34.62	34.43	36.15	36.40	36.74
Karnataka	25.94	27.27	28.22	29.20	30.61	31.05	32.27	31.53
Kerala	35.90	35.32	36.00	36.36	36.03	35.26	35.52	36.28
Madhya Pradesh	15.45	15.92	16.39	17.39	19.18	19.76	20.80	20.89
Maharashtra	28.05	28.92	28.88	28.37	28.34	28.86	29.28	29.24
Orissa	21.97	21.82	22.20	21.04	21.45	21.12	22.58	21.81
Punjab	74.16	74.86	75.19	74.25	74.21	74.14	73.75	73.59
Rajasthan	18.83	19.59	19.51	19.63	19.03	18.48	18.71	18.73
Tamil Nadu	44.69	46.36	46.86	47.02	47.61	48.98	50.79	52.13
Uttar Pradesh	39.82	38.38	38.31	37.92	38.08	38.23	39.31	40.01
West Bengal	41.67	42.14	42.22	41.19	41.79	41.66	43.00	43.32
All India	31.14	32.23	32.21	31.99	32.29	32.52	33.26	33.07
Coefficient of variations	39.51	39.08	39.20	38.87	38.30	38.13	37.01	37.43