POLICY PAPER 11

EMERGING TRENDS AND REGIONAL VARIATIONS IN AGRICULTURAL INVESTMENTS AND THEIR IMPLICATIONS FOR GROWTH AND EQUITY

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भाकृअनुप
ICAR

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Emerging Trends and Regional Variations in Agricultural Investments and their Implications for Growth and Equity

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Policy Paper 11

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Foreword

Public investment in Indian agriculture has generated considerable debate and interest. The debate lacks on two counts. One, most researchers have been using CSO series on public investment which consists largely of investments in irrigation and does not include such important heads like rural roads, rural electrification and several other items which are relevant and essential for growth and development of agriculture sector. The CSO series has inherent limitations, due to its restrictive coverage which affect further analysis. The present study constructs an alternative series on public investments for agriculture, which includes all major heads related to the development of agriculture. The new series reveals the true trend in investments made for agriculture sector and is more appropriate for studying the impact of public investment on private investments. Two, complete information on public investments in agriculture at state level has been missing. The present study constructs complete series on capital expenditure for agriculture for the last 23 years for each state of India.

The study explores determinants of private agricultural investment since 1980-81, which represent the phase of declining public investment in agriculture. The relationship between indicators of agricultural performance and investments has been analyzed and the implications of emerging trends in public and private investments on agriculture sector have been discussed. The findings of the study provide insights into the importance being accorded for development of infrastructure for 7agriculture and regional disparities in the same. I hope the paper would be useful to both researchers and policy planners as it addresses analytical issues and issues of policy relevance.

The study has been carried out by Dr Ramesh Chand and Ms Sonia Chauhan assisted him in data collection and report preparation. I thank and congratulate both of them for their painstaking effort in completing this work. I thank our peer reviewers Dr G K Chadhha and Dr C Ramasamy for their critical comments on the draft of the study which were immensely useful in improving the quality of the study.

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Dayanatha Jha
Director

Acknowledgements

This study has been undertaken to fill certain gaps in the data and in the research on public and private investments in Indian agriculture. Attempt has been made to construct alternative series on public investment in agriculture for the past 23 years for the whole country and for each state based on capital expenditure incurred on almost all the items meant for agriculture sector. The new series is quite comprehensive and does not pertain to irrigation investment alone, as has been the case with the CSO series. Thus, the new series is more powerful to explore relationships between public and private investments and public investments and agricultural performance. State level series on public investment have been reported by grouping yearly data in Five Year Plan periods. However, yearly data at state level can be provided to interested researchers.

The new series on public investment has been used to address research questions, like, nature of relationship between public and private investments, determinants of private investment at country level and at state level, and impact of public and private investments on agricultural productivity and growth across states.

Most of the data for the study have been collected from the government publications available in the "Ministry of Finance Library" North Block, New Delhi. I am grateful to the staff in the library for their extended help during data collection. I would like to give my special thanks to Ms. Savitri Devi, , in particular, for her enthusiastic help in providing needed publications. We have also consulted NIPFP library and CGO library of Ministry of Finance for getting the research material.

Ms Sonia Chauhan has contributed immensely for the study for which I thank her. I am indebted to Dr Dayanatha Jha, Director, NCAP for the institutional support and facilities provided for this study. Dr Jha also took considerable interest in the progress and results of the study and offered innumerable suggestions for its improvement. Professors B D Dhawan, A Vaidyanathan, Bhupat M Desai and D P Chaudhri and Dr V N Misra offered critical and valuable comments on the study. Due to various limitations it has not been possible for me to address all the points raised by them. I express my deep gratitude to them for the pains they took to read the study results. Dr Nelson Perera provided statistical package and expertise to test relationship between public and private investments. The material in the policy paper format has been set by Ms Umeeta Ahuja and Linu M Philip. I thank both of them.

EXECUTIVE SUMMARY

Time series information on public and private sector investments in different sectors of the Indian economy is provided by Control Statistical Organisation of Government of India. The CSO series show that public and private investments in agriculture have been moving on a rising trend till early 1980s. Based on this, it has been inferred that there is complementarity between public and private investments. However, after 1980-81, public sector investments started declining, in real term, and private investment did not follow public investments. On the contrary, private investment kept moving upward showing disparate movement in the two series since 1981-82. This has led to questioning of the widely accepted conclusion that private sector investment in agriculture is determined by the level of public investment, followed by debate on the determinants of private investment.

While addressing the issues related to relationship between public and private investments, researchers observed that CSO series on public investment does not include investments in several important heads like rural roads, rural electrification and markets. More than 90 percent of the public investment reported by CSO consisted of medium and major irrigation projects. Therefore, strong need was felt to have a comprehensive series on public investment in agriculture that includes all important items relevant for agriculture. It was also noted that statewise data on public investment in agriculture were not available, in the absence of which it was not possible to study implications of ongoing trend in public and private investment on regional growth and equity.

The present study has prepared new country level and state level series on public investment for the period 1974-75 to 1996-97 which include investments in about 23 heads relevant for agriculture sector. The series have been constructed by using capital expenditure on the concerned items as reported in the publication Finance Account of the union and state governments.

The broad series reveals that capital expenditure on agriculture by the union government during the period 1974-75 to 1996-97 did not increase even at current prices. In Bihar, annual capital expenditure on agricultural heads by the state followed decline after 7th Plan. At 1980-81 prices, capital expenditure on agriculture for the country as a whole showed decline throughout, beginning with the 5th Five Year Plan (1974-75 to 1978-79). The decline was very sharp during 6th and 7th Five Year Plans when annual capital expenditure on public account declined to Rs. 3637 and Rs. 2758 crore respectively from about 44 hundred crore during 5th Plan. Likewise, the capital expenditure by union government declined by 45-50 percent in each successive Five Year Plan following 5th Plan.

Among major states, per hectare public investments in agriculture remained highest in Jammu and Kashmir - it was about 4-5 times the national average in all the four Five Year Plans. Due to its special status, the state is receiving special assistance for various agricultural development projects as is the case with small size north east states. Among the remaining major states, Punjab allocated highest resources for infrastructure development for agriculture in all the plan periods. The second place from top was occupied by Himachal Pradesh during 5th Plan, by Uttar Pradesh during 6th Plan, by Maharashtra during 7th Plan and by Kerala during the 8th Plan period. State investment for capital formation in agriculture was quite low in Rajasthan and Madhya Pradesh. Likewise, Tamil Nadu, Assam, and West Bengal also invested low amount of capital in agriculture.

Among small size north east states and Goa, Daman and Diu, per hectare annual capital expenditure on agriculture during last 23 years varied between Rs. 500 to Rs. 1606 which is substantially higher than the average of the country. Thus, with respect to public investment northeast states, and Jammu and Kashmir have been the more favourable compared to major states.

All major states and some of the small states show declining trends in the resources spent for infrastructure for agriculture. At country level the series declined annually by 3.16 percent over the chosen period.

A comparison of net domestic product (NDP) from agriculture sector invested for capital formation in agriculture during different Five Year Plan periods shows a steep decline. During early 1980s more than 9 percent of NDP from agriculture was invested back for infrastructure development. During the second half of 1980s resources spent for agricultural infrastructure declined to 7.40 percent of NDP from agriculture. The decline continued during 1990s and current share of resources for capital formation is around 1 /20th of the sectoral output. Contributions from union government for capital formation in agriculture constituted about 1.80 percent of NDP from agriculture during late 1970s which has dwindled to 0.25 percent during the 1990s. Among major states, capital expenditure on agriculture in J&K corresponds to about 1 /4th to 1 /5th of NSDP agriculture in different plan periods which is found highest. Among the remaining major states Maharashtra spent highest proportion of NSDP agriculture (10-18%) on agricultural infrastructure. Agricultural investments on public account in states of Uttar Pradesh and Gujarat exceeded 8 per cent of NSDP during 5th Five Year Plan period. Assam, Bihar, Haryana, Kearala, Rajasthan, Tamil Nadu and West Bengal invested less than 5 percent of agricultural NSDP in the public capital during 5th plan. West Bengal remained at the bottom throughout in respect of agricultural investment. In Bihar, share of public investment in agricultural NSDP dropped from around 6 percent during 1980s to less than 2 percent during the 8th Plan. Though Haryana is agriculturally progressive state, its proportionate allocation of NSDP agriculture for farm investment remained lower than the national average.

For the country as a whole, 4 percent of total national income was spent for infrastructure development for agriculture sector during 5th Plan period. This share kept falling over time and during 8th Plan period less than one and a half percent of national income was ploughed back for capital formation in agriculture.

In the series covering almost all heads of public investment relevant for agriculture, major and medium irrigation projects continued as the dominant item of capital expenditure. Investments in storage and warehousing were the second most important item of capital expenditure with 25-29 per cent share. These two heads account for about 2/3rd of the total capital expenditure on agriculture by states and union government in the country. Crop husbandry was the third important item of capital expenditure during 1974-75 to 1978-79 with about 15 percent share in total capital expenditure on agriculture, however, its importance diminished subsequently. Investment in district and other rural roads with an investment of around Rs. 200 crore turned out to be the third most important item during 7th and 8th Plan periods. Capital expenditure in rural electrification remained below Rs. 10 crore till 1989-90 and increased to Rs. 44 crore per year during 1990s. Importance accorded to create infrastructure for dairy development declined sharply after 5th Plan period. Public capital invested in fertilizer industry was around Rs. 266 crore per year during 5th Plan, Rs. 130 crore during 6th Plan and Rs. 71 crore during 7th Plan. Annual investment in fertilizer industry declined to around Rs. 20 crore during the 1990s. Combined capital expenditure on hill and north - east areas and on other special area programmes has been steadily increasing despite the decline in overall capital expenditure on agriculture.

A comparison of CSO series and the broad series constructed by us shows that the CSO series underestimated the public investment in agriculture to the tune of 52 percent. Capital expenditure on irrigation development consisting of major, medium and minor irrigation works, command area development and flood control comprise about 95 percent of the public investment in agriculture as per CSO during the last 23 years.

The trend in broad series vis a vis CSO series reveals that the decline in former started a little earlier then the latter series. Thus, it is not correct to say that public investment for agriculture which includes all major heads like rural roads, rural electrification, storage, warehousing etc. has not declined even-though CSO series has declined. Further, the rate of decline in capital

expenditure on irrigation and allied heads was lower compared to the rates of decline in capital expenditure on other agricultural heads and in CSO series.

Information on private fixed capital formation in agriculture at country level is furnished by CSO but this information at state level is not available on yearly basis, except for one or two states. State level information on private capital formation in agriculture can be derived from the nation wide surveys conducted at 10 years interval. We have used the information available for the years 1981-82 and 1991-92 from the nation wide surveys to estimate statewise private investments in agriculture. According to the nation wide surveys about 87 percent of fixed capital formation in agriculture (FCFA) came from cultivator households though there is variation in it across sates.

During 1981-82, Punjab ranked at number one in per hectare private investments, but it showed sharp decline in the following decade at constant prices. Kerala, Tamil Nadu, Himachal Pradesh and Haryana were among top states with respect to per hectare private fixed capital formation in agriculture during 1991-92. Private investment per hectare of net sown area was awfully low in Orissa, Bihar, West Bengal and Assam. Rajasthan and Madhya Pradesh recorded very high growth in private investment in agriculture during the decade following 1981-82. In sharp contrast to public investment, capital invested by private sector in agriculture in the smaller states was meager and lower than all major states.

Almost all the past studies have used raw time series to establish relationship between public and private investments. This can give spurious relationship if assumption of stationarity of the series is not satisfied. In this study we have proceeded by applying Augmented Dicky Fuller Test (ADF) to test the time series on public and private investment for their stationarity and then used Cointegration analysis to examine the relationship between public and private investments. The results show that raw series were not stationary. The series at first difference turned out to be stationary. Further analysis shows that there is no long term relationship between the two series. The positive or negative association observed by various researchers between the raw series of public and private investments in different periods is spurious as there is no true long term relationship between the two series.

Private investment in agriculture may be affected by several variables and their interactions. To see the impact of public investment on private investment in the presence of other relevant variables and to find out determinants of private investments the study used CSO series and broad series on public investment at national level. Country level data show that the terms of trade for agriculture and institutional term credit advanced to farmers have positive and significant impact on private capital formation in agriculture. Public investment, both as per CSO and as per the broad series which include all important heads of capital expenditure, did not show positive impact on private investment.

The results based on state level data show that during 1981-82, both public sector investments in agriculture as well as institutional term loans to farmers exerted positive and significant impact on private sector capital formation in agriculture. However, during 1991 -92 public sector capital expenditure ceased to cause significant influence on private sector capital formation.

The relationship of agricultural growth and agricultural productivity with public sector capital expenditure and private sector fixed capital formation has been studied using data for the major states. Both, the public and private investments in agriculture show positive and significant impact on agricultural productivity. However, the impact of public investment on the growth of agricultural output was not significant. On the other hand, impact of private investment on output growth turns out to be highly significant. The impact of total investment on public and private account was positive and significant on both, agricultural growth as well as productivity.

Among various states, West Bengal recorded highest output growth and productivity though agricultural investment in this state was lowest. This was attributed to factors such as

Operation Barga. This also shows that beside public and private investments there are other powerful instruments for agriculture development.

As the agricultural productivity and output growth are significantly affected by the level of fixed farm investment, one way to reduce large interstate inequalities in agricultural development in the country was through balanced allocation of capital expenditure for agriculture. The inequality in public capital expenditure per hectare of net sown area among major states followed decline during 1974-75 to 1991-92 but it showed a sharp increase during the recent years.

The ICOR based on CSO investment series and the broad series indicate that the marginal efficiency of capital in Indian agriculture improved till 1989-90 and deteriorated in the subsequent quinquennium. Compared to the estimates of ICOR obtained by this study the Planning Commission has been using quite lower estimates. Accordingly, sectoral needs for investment in agriculture by Planning commission to attain projected output level were highly on lower side.

The study shows that there is a widespread decline across the board in all the states in public sector capital expenditure for agriculture. The decline is not confined to investment in irrigation projects; it is rather more sharp in other heads related to agricultural development.

The lack of complementarity between private and public investment stands out prominently. Terms of trade for agriculture and flow of institutional credit are found to be the strong determinants of private investments in agriculture. Private investment is found to be more effective than public investment in promoting output growth.

There is a need to examine why public investments have non significant or even negative impact on private investments after early 1980s. It seems the impact of public investment on private investment would vary depending upon type of public investment in different regional settings. AH kind of public investment may not lead to or induce private investment. Some of the private investment in Indian agriculture may be induced by public investment and some may be autonomous. Misplaced priorities and leakages in public investments are the other reasons for lack of inducement effect on private investments.

Importance and role of public investment to create infrastructure and to promote long term agricultural growth should not be undermined by lack of complementarity between public and private investment. However, public investment would be effective in playing this role only if it serves the purpose for which it is created. There are instances when huge investment made in infrastructure in some areas soon ceased to serve its purpose due to lack of maintenance.

The declining trend in public sector agricultural investment should be reversed by increasing allocation in all the major states to check adverse impact on agricultural output. There is also a need to improve efficacy of public investment in agriculture so that it serves the purpose for which it is created. It would be prudent to encourage private investments through institutional credit support and favourable terms of trade for agriculture. In particular, flow of institutional credit should be increased to the states having low level of private investments, like eastern states.

1 INTRODUCTION

The purpose of investments in any sector is to generate capital in the form of infrastructure, improvement in quality of natural resources and assets, and creation of productive assets. The importance of capital in economic progress has been recognised long back (Cairncross, 1955; Meir, 1964). Several development economists see investment as the most important single factor in the growth process (Rostow, 1960; Lewis, 1955).

Investment in any sector comes from two sources viz. public and private. While public investment is meant mainly to create infrastructure, private investment is used mainly for assets formation and for improvement in quality of existing assets. Traditional agriculture and agriculture in underdeveloped countries is generally starved of investment resources because private capital is deterred by the risk involved in agriculture (Schultz, 1964) and institutional investment has also been meagre (Shonfield, 1960). Therefore, special efforts and attention are required to direct and induce public and private investments in agriculture in underdeveloped countries. More so, because agriculture sector in such countries accounts for dominant share of economy, and, growth of other sectors and the overall economy depend to a large extent on the growth of agriculture sector (Timmer, 1988; Nicholas, 1964).

Given the importance of investment in economic growth, there has been a considerable interest in the factors affecting investment during different periods and stages of development. While public investment is determined largely as a matter of policy and by availability of funds from external sources like foreign economic aid and investment, private investment is affected by a variety of factors which differ over time and space.

Beginning with the seminal work of Ragnar Nurkse (Nurkse, 1953) in early 1950s, a large number of studies have been conducted in all the countries on capital formation and investments in agriculture sector to reflect the changing context. The foremost study in the area of capital formation in agriculture in India has been done by Tara Shukla (Shukla, 1960). This study prepared the estimates of value of durable physical assets, capital stock and capital formation for selective years during 1920-21 to 1960-61 at country level and for the selected states using data from Agricultural Statistics of India, Livestock Censuses and various other reports. The estimates pertain to capital in the private sector. After that, the theme had been discussed in several conferences and seminars and has received the attention of several researchers.

Subsequently, the work of estimation of capital formation in various sectors of the economy has been undertaken by Central Statistical Organisation (CSO) of government of India, and the estimates of public and private investments are a part of National Accounts Statistics. The estimates of public and private investments at the country level are available from 1950-51 onwards; the coverage and methodology used to prepare such estimates is described in CSO publication National Accounts Statistics: Sources and Methods (CSO 1989).

The CSO series has been widely used by several scholars to study investments and capital formation in Indian agriculture. This series shows that public investment in agriculture has been rising steadily till 1980-81 and thereafter it started moving downward. Serious concern has been expressed by various scholars over the declining trend in public investment (Shetty, 1990 Kumar, 1992) and it has generated a renewed interest in the area of agricultural investments in India. It has been asserted that decline in public investment is bad not only in itself but also because it would lead to decline in private investment due to complementarity between public and private investment.

A cursory look at the CSO series at constant prices reveal that both public as well as private investments were moving on rising trends in tandem with each other till late 1970s (Table 1.1; Fig. 1.1). Based on this, some studies concluded that there is a high complementarity between the two types of investment (Krishnamurty, 1985; Bhattacharya and Hanumantha Rao, 1986; Shetty, 1990; Hanumantha Rao, 1994) while some scholars have described it as the inducement effect of public investments on private investments (Patnaik, 1987; Rath, 1989).However, actual behaviour of the two series shows that after reaching the peak in 1980-81, public investment started moving downward whereas private investment continued to rise. Thus, private investment since early 1980s did not follow the public investment, contrary to what has been asserted by the above mentioned studies on relationship between the two types of investments.

Mishra and Chand (1995) were first to note the disparate movement in the two series on agricultural investments. They contended that there was no apparent complementarity between public and private investment and that private capital formation in Indian agriculture may be partly induced by public Sector and partly autonomous. But their findings have not been totally Accepted by some researchers and the issue has been debated at som length (see Dhawan and Yadav, 1995; Alagh, 1997; Mitra, 1997).

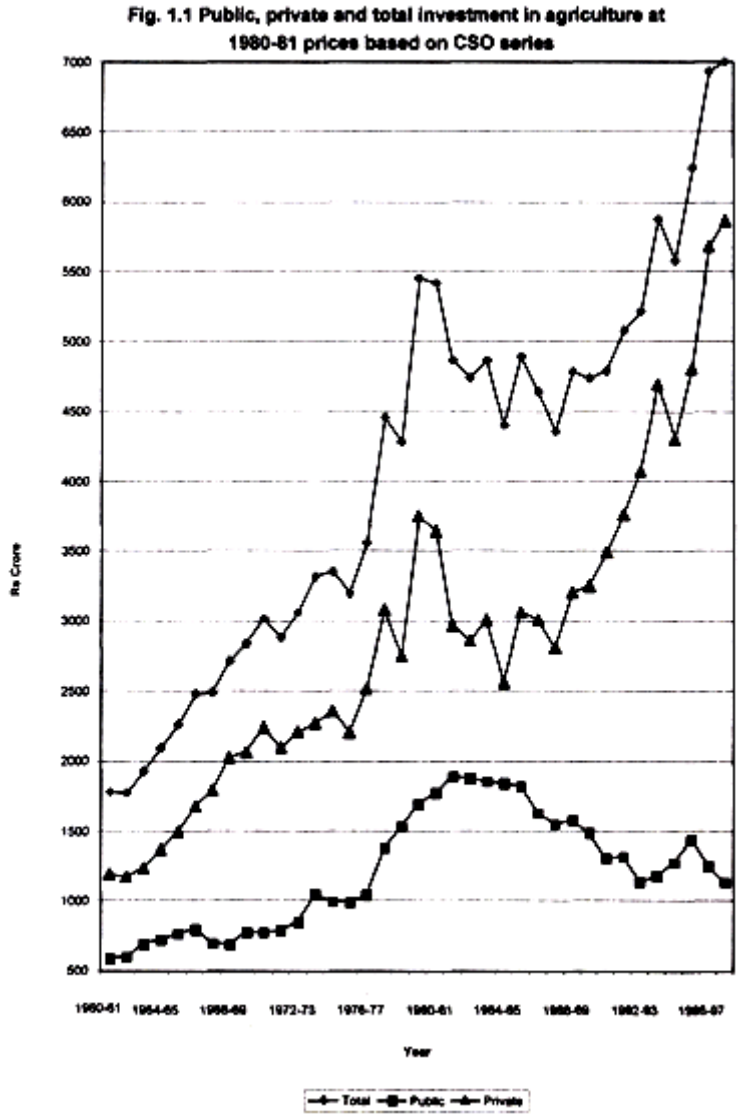
Table 1.1: Public and private investments in agriculture at current and 1980-81 prices

Rupees crore

Gross capital formation in agriculture (GCFA)						
Year	**At current price**			**At constant price**		
	Total	**Public**	**Private**	**Total**	**Public**	**Private**
1960-61	448	126	322	1777	589	1188
1961-62	418	134	284	1773	600	1173
1962-63	467	158	309	1928	694	1234
1963-64	518	167	351	2094	725	1369
1964-65	610	197	413	2262	765	1497
1965-66	720	225	495	2478	798	1680
1966-67	806	215	591	2486	696	1790
1967-68	933	225	708	2714	688	2026
1968-69	1022	272	750	2838	775	2063
1969-70	1156	293	863	3016	775	2241
1970-71	1214	329	885	2884	789	2095
1971-72	1378	382	996	3059	851	2208
1972-73	1606	505	1101	3317	1049	2268
1973-74	1881	567	1314	3352	993	2359
1974-75	2089	591	1498	3195	991	2204
1975-76	2523	718	1805	3556	1041	2515
1976-77	3296	1013	2283	4457	1378	3079
1977-78	3357	1206	2151	4281	1534	2747
1978-79	4404	1391	3013	5447	1697	3750
1979-80	4976	1618	3358	5414	1772	3642
1980-81	4867	1892	2975	4864	1892	2972
1981-82	5447	2066	3381	4741	1878	2863
1982-83	6081	2275	3806	4865	1857	3008
1983-84	6118	2495	3623	4406	1843	2563
1984-85	7006	1679	5327	4888	1822	3066
1985-86	7582	2811	4771	4641	1631	3010
1986-87	7740	1901	5839	4360	1550	2810
1987-88	9188	3311	5877	4782	1580	3202
1988-89	9979	3445	6534	4737	1485	3252
1989-90	11008	3347	7661	4791	1301	3490
1990-91	12853	3628	9225	5076	1315	3761
1991-92	14776	3653	11123	5212	1135	4077
1992-93	18113	4175	13938	5873	1179	4694
1993-94	18708	4920	13788	5574	1272	4302
1994-95	24520	6022	18498	6244	1438	4806
1995-96	29335	6557	22778	6927	1250	5677
1996-97				6999	1132	5867

Source: National Accounts Statistics, CSO various issues.

Fig. 1.1 Public, private and total investment in agriculture at 1980-81 prices based on CSO series



Studies have also been taken up to ascertain the determinants of private investment in agriculture if indeed private investment is not determined by the public investment (Dhawan, 1996b, 1997; Misra and Hazell, 1996a, 1996b, 1997).

In the meantime, researchers also looked into the definitional aspects of public investment estimates of CSO, to understand the implications of falling public investment in agriculture. This has brought to the fore the restrictive nature of the CSO series on public investment in agriculture, which is found to be largely consisting of investment in irrigation. It has been reported that 90 per cent of the investment in the CSO series on public investment in agriculture comprises investment in irrigation (Hanumantha Rao, 1997). Public investment in important infrastructures like market, storage, rural roads and rural electrification is not included in CSO series. This raises two important issues. One, what would be the trend in public investment in agriculture when important items of infrastructure for agriculture are also accounted for. Two, could the absence of complementarity observed by some researchers based on the CSO data be attributed to the missing items of public investments?

Another important limitation of the available CSO series is that the 'country level' estimates of public and private investments are prepared indirectly based on information derived from output trend, savings behaviour and nation wide sample surveys on agricultural investments etc. The country level estimates of investments are not aggregate sum of state level estimates. Thus, state level estimates of public and private investments corresponding to national estimates are not available. Whereas, to

understand the causes and implications of the observed macro trends there is a need to look at region/state wise data on public and private investments. The present study is an attempt to provide alternative series of public investment in agriculture that overcomes the limitations of the CSO series. The series is constructed both at national and state levels. While the CSO series on "Public Investment in Agriculture" has a very narrow coverage, the new series covers almost all important components of agricultural infrastructure. The new series on public investment has been constructed for all the states and for the country.

The questions attempted to be answered in the study are:

1. What is the exact relationship between public and private investments, and investments and growth of output?
2. What are the factors that determine private investment?
3. Does the decline in public sector capital formation during recent years imply that infrastructure development in agriculture is receiving lower importance in the country?
4. Which region should be accorded higher priority in allocation of public investment in agriculture?
5. Is it necessary to make public investments in each state/region every year to encourage private investment there, or, public investment made at one time creates enabling conditions for private investments for many years to come, such that, private investment in those regions where high level of public investment has already been made would not be affected? Thus, when resources are limited, can public investment be diverted from the regions which have already received higher public investment to the neglected or less developed regions without affecting private investment and output growth in the former. The answer depends on whether the complementarity hypothesis holds or not.

1.1 Objectives

1. To construct a new and broad series on public investment in agriculture at country level and at the state level and to discuss the changes in composition of public investment during the last two decades.
2. To explore the nature of relationship between public and private investments in agriculture and to find the determinants of private investment.
3. To study the impact of private and public investments on agricultural growth and productivity.
4. To study regional divergence in agricultural investments and to analyze its implications for balanced regional development.
5. To discuss the policy implications of current trends in public and private investments.

1.2 Organisation of the Study

The study is organized into seven chapters including Introduction. Chapter 2 presents the debate on complementarity between public and private investments and determinants of private investment. It also reviews important recent studies on trends in public and private agricultural investments, and causes and implications of these trends. Sources of data and method of inquiry are presented in Chapter 3. New estimates of public investment for the past two decades for each state and country are presented in Chapter 4. The new estimates are also compared with the CSO series. The Fifth chapter examines inter state variations in private investments and analyses determinants of private investment in agriculture. Relationship between agricultural investments and agricultural growth and productivity is investigated in Chapter 6. The Chapter also examines the divergence in inter state public and private investments and discusses its implications for regional equity. Sectoral ICOR analysis is also attempted in this Chapter. Conclusions and policy implications of the study are presented in Chapter 7.

2 REVIEW Of PAST STUDIES

Quite a few studies have been undertaken during the last 10 years on public and private investments in Indian agriculture. These studies have mainly dealt with three aspects, namely (i) trend in public, private and total investments - the causes and implications, (ii) relationship between public and private investments, and (iii) determinants of private investments.

2.1 Trend in Agricultural Investment

The C.S.O series on public investment in agriculture available since 1960-61 showed a rising trend till 1980-81, stagnation at that level for 4-5 years and a decline thereafter. Attention to this fact has been drawn by several scholars (Rath, 1989; Shetty, 1990; Kumar, 1992; Hanumantha Rao, 1994; Alagh, 1994) and it has also been acknowledged by official sources (Economic Survey, 1993-94; Planning Commission, 1994).

This decline in public investment is attributed to various factors. One explanation for this is the diversion of resources from capital account to current account to meet mounting input subsidies in agriculture. As agricultural subsidies increased tremendously after! 980-81 (Gulati and Sharma, 1997) it put massive strain on fiscal resources. Accordingly, rise in subsidies is recognised as a major constraint for raising public sector investment in agriculture (Gulati and Sharma, 1997; Hanumantha Rao, 1994). Some scholars attributed decline in public investment in agriculture to the bias against agriculture in the policy (Kumar, 1992).

Another explanation for the observed behaviour of public investment in agriculture during the 1980s owes itself to political economy of agricultural policies. Under the pressure of farmers interest groups, public financing of private sector capital formation became the priority concern in the beginning of 1980s, (Mishra and £hand, 1995). Public financing of private investments rose from 35 percent in the green revolution period to 60 percent in the post green revolution period and this did not leave much room for the state for public investments. Extraneous forces like opposition to major and medium irrigation systems by environment groups and inter state disputes on water sharing also had adverse effect on public sector investment, which has been largely for irrigation development.

As the public investment is meant for infrastructural development and it augments productive capacity, the level of public investment is crucial for long term growth of output. Accordingly, it has been pointed out that the decline in public investment in agriculture that set in during early 1980s would have adverse impact on the growth of agricultural output (Rath, 1989). Kumar (1992) predicted that the decrease in share of agricultural investment in the total for the economy will cause a significant fall in agricultural GDP. Though, during the decade of 1980s, agricultural GDP and its growth rate did not fall following the decline in public investment, as predicted, there is no disagreement about the importance of public investment for long run output growth.

While acknowledging the importance of public investment for growth of output, some researchers have drawn attention to the distinction between Investment in agriculture and investment for agriculture. It is felt that the CSO series on public investment termed as investment in agriculture includes investment mainly under medium and major irrigation systems. The series does not include investment in rural roads, markets, godowns, storage, rural electrification etc. which are for agriculture, and which are quite important for growth and development of the sector. Therefore, it is said that if there is a decline in public investment in agriculture based on the CSO series, it may not necessarily imply a decline in investment for overall infrastructure for agriculture development. This underscores the need to examine the trend in public investment that includes all major items of investment related to the sector. At the same time the decline in public

investment based on CSO series cannot be overlooked. If this decline reflects deecrease in irrigation investment, it has serious implications for growth of farm output as 2/3rd of agriculture is still rainfed, and, extension of irrigation is the most effective method of raising farm output in the country.

2.2 Complementarity between Public and Private Investment

There was a very strong positive association between public and private investments in agriculture till 1979-80. Based on this, some studies inferred that there is a high complementarity between public and private investment in agriculture (Krishnamuty, 1985; Bhattacharya and Rao, 1986). After 1980-81 the series on public and private investments started showing disparate trend and the association between the two series turn out to be negative. Thus, a very strong positive association between the two series in the earlier period turned out to be negative and significant during the 1980s. Based on this Mishra and Chand (1995) observed that the nature of association (positive or negate) between the two series depends on what time period one chooses for estimating the relationship between public and private investments in agriculture. The study refuted the claim of high complementarity between public and private investments in agriculture and concluded that private investment may be partly induced by public investment and partly autonomous.

The phenomenon of complementarity was considered so obvious that its refutation led a couple of researchers to examine it further. The first attempt in this direction was made by Dhawan and Yadav (1995). They used the data from the All India Debt and Investment Survey 1981-82 of Reserve Bank of India to prepare estimates of per cultivator fixed capital formation in agriculture on private account for 17 major states and analysed its relationship with other relevant variables, including some indicating public investment in agriculture. The authors estimated several regression equations using per cultivator fixed capital expenditure in major states as dependent variable and found strong positive impact of per cent of net canal irrigated area in net sown area in 1980-81 on the former. Based mainly on this, the study concluded that complementarity between private and public investments in agriculture cannot be given up. Dhawan (1995) further asserted based on some results presented in another paper that, since development of canal irrigation accounts for a major share of public investment in Indian agriculture, positive impact of percent of net sown area irrigated by canal on private capital formation gives credence to complementarity hypothesis.

The methodology used by Dhawan (1995) to establish the complementarity does not appear to be appropriate. Area under canal irrigation in a given year is cumulative sum of the area brought under such irrigation during past several years - it may include irrigated area and investment in that made 50 years or even 100 years ago. Can we then say that public investment that is created 50 years or even 100 years ago has induced private investment in 1981-82? The relationship being studied is in capital formation or investment in public sector vis a vis private sector during a given time period whereas the area under canal irrigation in a particular year corresponds to capital stock or cumulative investment. Thus, even if area under canal irrigation is to be used as indicator of public investment the appropriate measure is addition made to that area or the potential created during say last few years depending upon the lag assumed between private and public investments. Moreover, positive association between public and private investment series ceased to exist after 1981-82. Subsequently, Misra and Hazell (1996) examined the complementarity hypothesis using C.S.O data with the help of multiple regression by including other relevant variables like terms of trade and area under HYV beside public investment as the factors affecting private investment in agriculture. The study found that role of public investment in influencing private investment has turned out to be weak. They concluded that the complementary relation between public and private investments had ceased to exist during 1980s.

Hanumantha Rao (1997) is of the view that the controversy over complementarity has arisen due to limitation of CSO data, more than 90 percent of which relate to investment in medium and major irrigation projects. He felt that if public investments made in agriculture are properly accounted for by including investment in rural electrification, rural roads, storage etc. then complementarity between public and private investments stands out prominently.

Dhawan also did not agree with the method and conclusion of the study by Mishra and Hazell (Dhawan 1996). Another critique of refutation of complementarity hypothesis appeared in Alagh (1997) where he asserted that the complementarity of public and private investments can be seen more strongly in project level data - the conclusion similar to that of Mishra and Chand (1995) as is evident from the following quote:

"Investment planning literature at micro level generally deals with competitive investment projects. However, there again, we come across cases of complementary projects. Investment in field-channels, for example is complementary to a canal irrigation project, because in the absence of the former, irrigation benefit from the latter cannot materialise".

Taking this case, it looks pertinent to point out that investment in field channels can come from private source or from public source. In case field channels are constructed using public funds, as has been done in some states, it is a case of crowding out effect.

The trend in public and private investments in agriculture since 1950-51 and phenomenon of complementarity has been examined thoroughly by Mitra (1997). The study observed that though, based on CSO series the complementarity hypothesis appears to stand refuted during 1980s, this did not imply that the relationship could be one of substitution or of independence between the two.

The debate shows that the serious disagreement on whether there is complementarity between public and private investments in Indian agriculture still persists. However, the debate has been quite useful to improve our understanding of the complex nature of relationship between the public and private investments in agriculture.

2.3 Determinants of Private Investment

Only a few studies during the last decade have studied the determinants of private investment in agriculture at macro level. Public investment was considered quite an important determinant of private investment whether termed as complementarity effect or inducement effect. Empirical model based on economic theory of investment was developed by Gandhi (1990) to analyse investment behaviour in Indian agriculture. The results based on the model show significant positive impact of government investment in agriculture on private investment. The model was run on C.S.O series for the period 1951-80. Gandhi further analysed determinants of private investment by extending the model to post 1980 period when trends in public and private investment started moving in opposite directions (Gandhi 1996). The study found that for the entire period 1952-53 to 1992-93 rural savings and co-operative credit to agriculture were the strongest determinants followed by HYV coverage, agricultural wages and commercial bank credit.

Rural savings emerged as a strong determinant of private investment in agriculture from 1980-81 to 1992-93.

Misra and Hazell (1996) observed that terms of trade and technology (measured by percent area under HYV) have significant positive impact on private investment. The impact of public investment turned out to be non significant which has also been confirmed by another study by Misra (1998).

3 DATA SOURCES AND METHOD

As discussed earlier, CSO series on public and private investment is available separately since 1950-51 at the country level. The objective of this study was to construct a new series at the country and state levels that includes investments in all broad heads meant for agriculture. Various sources were explored from where state level data on investment on all the relevant items could be obtained. After a through survey it was found that the publication Finance Accounts of union government and the states provides detailed information on headwise and sub-headwise capital expenditure during each year. Therefore, this was used as the source of basic data for investment on public account.

The series has been constructed for the period 1974-75 to 1996-97, starting with the first year of Fifth Five Year Plan and ending with the last year of Eighth Five Year Plan. The classification of various heads of expenditure in Finance Accounts is the same as that followed in the "Budget documents". There was a change in classification of expenditure under various heads beginning 1986-87 when the system of accounting was shifted from three digits to four digits classification and uniformity was brought between development heads of expenditure and budgetary heads of expenditure. The items included in capital outlay on agriculture in our series and their correspondence between the two sub-periods i.e. up to 1986/87 and 1987/88 onwards are shown in Table 3.1. The series includes capital expenditure on more than 20 heads about half of which are not included in the C.S.O series.

Yearly data on capital expenditure, termed as public investment, by each state and union government have been compiled for the last 23 years. The series has also been prepared at constant (1980-81) prices by deflating the current price series by implicit price index of construction sector.

Time series data on private investment at state level is not available on annual basis. However, state level information for the study period is available from nation wide surveys like Debt and Rural Investment Survey 1981-82 by Reserve Bank of India and Household Capital Expenditure During 1.7.1991 to 30.6.92: Debt and Investment Survey of NSSO, 48th Round. The 1981-82 survey provides information for 17 major states while 1991-92 information is available for all the states. The NSSO survey covers 36425 rural and 20606 urban households, spread over all the states. Both these surveys give rich information on fixed capital expenditure by rural and urban households. The data on capital formation by household is furnished under three heads, viz. (a) residential plots and buildings, (b) farm business, and (c) non-farm business.

Table 3.1: Various heads of capital expenditure in agriculture and allied activities and their equivalence for pre 1987-88 and post 1987-88 periods.

S.No.	1987-88 onwards Head	1974-75 to 1986-87 Corresponding head
4401	Crop husbandry	Head 505- agriculture research, storage and marketing
4402	Soil and water conservation	Head 506-minor irrigation
4403	Animal husbandry	Head 510
4404	Dairy development	Head 51 1
4405	Fisheries	Head 512
4406	Forestry and wild life	Head 51 3
4407	Plantations (included in 4401)	None, included in 505
4408	Food, storage and warehousing	Head 509 food + storage and warehousing + marketing from 505
4415	Agricultural research and education	Agricultural research from 505
4416	Investments in agriculture Financial Institution	Head 51 5
4425	Cooperation	Head 498
4435+4575	Other rural development and special area programmes	Head 51 4
4551+4552+ 4575	Hill areas and north eastern areas	Head 499
4701+4711	Major and medium irrigation and flood control projects	Head 532+Head 533
4702	Minor irrigation	From 506
4705	Command area development	None
4801(06)	Rural electrification	Head 534
4855	Fertilizer industries	Head 523
5054	District roads	Head 537

The statewise estimates of private capital formation in agriculture were arrived at by multiplying per household capital formation in farm business by the number of households in respective rural-urban categories, from which per hectare estimates were prepared. The study also uses CSO estimate of private investment at country level.

The relationship between public and private investment has been investigated using cointegration analysis. Determinants of private investments are analysed using multiple regression analysis framework. The impact of private and public investment on agricultural productivity and growth rate of agricultural output across states has also been studied.

4 STATEWISE TREND IN PUBLIC INVESTMENT IN AGRICULTURE

Public investment in agriculture in India is funded by state governments and the union government. Contributions of each state and the union government from 1974-75 were compiled headwise and their sum indicate the total public investment in agriculture. It may be noted that public investment in agriculture according to our series refer to capital expenditure on all the selected heads. Though we have prepared annual series for the period 1974-75 to 1996-97, for sake of brevity the information at state level is presented by grouping years according to the period of Five Year Plans. However, complete series is provided for the country as a whole. The reason for choosing Five Year Plan periods rather than any other grouping of years was that development resources in the country are mainly allocated according to Five Year Plans.

4.1 Total Public Investment

Trend in total public investment in each state at current prices is presented in Table 4.1 and the same at constant prices is presented in Table 4.2. Total public investment at country level at current prices steadily increased from Rs.2586 crore during 5th Five Year Plan to Rs.11964 crore during the 8th Five Year Plan. The capital expenditure on agriculture showed increase at current prices in all the states except Bihar and Punjab. In Bihar, annual investment in agriculture by the state government followed decline after 7th plan. The decline in Punjab set in after 6th Plan, however, there has been a substantial increase in public investment from 1992-93 to 1996-97. Like these two states, capital expenditure on agriculture sector by the union government also did not show rising trend. Agricultural investments by union government declined from Rs.654 crore/year during 6th plan to Rs.534 crore during Seventh plan. During the two years intervening 7th and 8th plan, union government invested very low amount in capital items.

Capital expenditure on agriculture at 1980-81 prices for the country as a whole showed decline throughout after 1974-75 to 1978-79. The decline was very sharp during Sixth and Seventh Five Year Plans when annual expenditure declined to Rs.3637 and Rs.2758 crore, respectively, from about 44 hundred crore during Fifth Plan. The decline continued during the 1990s though it was small (Table 4.2).

Table 4.1:
Capital expenditure on agriculture and allied heads at current prices, 1974/75 to 1996/97

Rs. Crore/year

States	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 and 1991-92	1992-93 to 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Andhra Pradesh	124	212	339	372	795
Assam	26	69	120	165	144
Bihar	101	235	391	314	250
Gujarat	133	207	277	676	769
Haryana	47	103	115	123	323
Himachal Pradesh	14	25	36	46	64
Jammu & Kashmir	66	101	176	307	385
Karnataka	102	178	217	336	755
Kerala	48	86	114	178	280
Madhya Pradesh	111	296	441	533	554
Maharashtra	.423	785	1241	1559	2206
Orissa	72	172	237	302	384
Punjab	210	393	309	162	1157
Rajasthan	81	151	194	285	605
Tamil Nadu	52	69	101	155	191
Uttar Pradesh	352	828	918	1501	1781
West Bengal	64	79	108	145	243
Goa, Daman & Diu	15	25	42	84	90
Arunachal Pradesh	5	17	40	65	102
Manipur	12	23	36	67	76
Meghalaya	5	10	19	39	63
Mizoram	4	12	23	33	50
Nagaland	7	20	29	33	21
Sikkim	2	6	11	18	22
Tripura	11	39	77	109	92
Union government	503	654	534	284	560
All India	2588	4797	6141	7892	11964

Likewise, the capital expenditure by the union government declined by 45-50 percent in each successive Five Year Plan following 5th Plan. At real prices, annual fixed capital expenditure on agriculture by the union government plummeted to Rs.122 crore during 1992-93 to 1996-97 as against Rs.883 crore during the period 1974-75 to 1978-79. This was the sharpest decline compared to states.

Table 4.2:
Capital expenditure on agriculture and allied heads at 1980-81 prices, 1974/75 to 1996/97

Rs. Crore/year

States	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 and 1991-92	1992-93 to 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Andhra Pradesh	202	162	151	125	181
Assam	43	51	53	55	33
Bihar	166	179	174	107	57
Gujarat	229	155	121	225	169
Haryana	76	79	53	41	76
Himachal Pradesh	23	19	16	15	14
Jammu & Kashmir	111	78	76	103	86
Karnataka	169	136	97	112	168
Kerala	80	66	51	59	63
Madhya Pradesh	184	222	195	179	126
Maharashtra	727	599	549	527	489
Orissa	118	133	106	101	86
Punjab	354	299	149	54	260
Rajasthan	136	118	85	96	131
Tamil Nadu	90	52	45	51	43
Uttar Pradesh	585	626	419	506	393
West Bengal	107	63	48	49	53
Goa, Daman & Diu	25	19	18	29	20
Arunachal Pradesh	8	13	17	22	23
Manipur	20	18	16	23	16
Meghalaya	7	8	8	13	14
Mizoram	9	9	10	11	11
Nagaland	12	15	13	11	5
Sikkim	3	4	5	6	5
Tripura	18	29	34	37	21
Union govt.	883	486	248	95	122
All India	4383	3637	2758	2653	2666

Barring small states, decline in capital expenditure on agriculture in real terms was observed to be widespread across states. Capital expenditure dropped sharply during 6th and 7th Plan periods in southern states, Gujarat, Rajasthan and West Bengal. Agricultural investments showed some improvement, during 1992-93 to 1996-97 in these states except in Tamil Nadu. In Assam, public capital expenditure showed rising trend till 1991-92 and declined thereafter. In Bihar, the decline is observed after mid 1980s. In Orissa and Maharashtra, agricultural investment by the states showed decline throughout after 5th Plan. In Punjab, annual investment by state declined from the level of 300 crore during first half of 1980s to 150 crore during the second half. It further reduced to 1/3rd during the first two years of 1990s after which it took a sharp upward turn. The investment pattern in Punjab seems to be highly affected by the rise of militancy movement in the state. Public investment in the state was severally curtailed during late 1980s and early 1990s with the rise of militancy, as more and more resources were diverted to control the militancy movement. As soon as the movement started fading and after the long pending election to state assembly in 1992, level of public investment was raised close to the level prevailing before beginning of militancy.

4.2 Per Hectare Public Investment

In order to compare the importance given by different states to agricultural infrastructure the series on capital outlay was computed on per hectare basis by dividing total capital expenditure by net sown area of the state. The estimates for different sub periods are presented in Table 4.3 while the movement in the entire series can be observed from the graphs in Fig. 4 1.

Among major states the capital expenditure on agriculture remained highest in Jammu and Kashmir - it was about 4-5 times the national average in all the four Plans. The magnitude of investment in Jammu and Kashmir was more close to smaller states than the major states. As the state enjoys special status in the Indian union, it has been receiving special assistance for various agricultural development projects. This has resulted in different pattern of public capital invested in agriculture compared to other major states. Among the remaining major states, Punjab allocated highest resources to infrastructure development for agriculture in all the Plan periods. Per hectare annual capital expenditure in Punjab was Rs.853 during 5th Plan, Rs.713 during 6th Plan, Rs.355 during 7th Plan and Rs.618 during the 8th Plan period. The second place from top was occupied by Himachal Pradesh during 5th Plan, by Uttar Pradesh during 6th Plan, and Maharashtra during 7th Plan. Kerala, with per hectare allocation of Rs.282 at constant prices, enjoyed 2nd position during the 8th Plan period.

Public capital invested in agriculture was the lowest in Rajasthan during 1974-75 to 1991-92; the amount at 1980-81 prices varied between Rs.60 to Rs.90 per hectare of net sown area. During 1992-93 to 1996-97, the state of Madhya Pradesh invested lowest in agriculture sector (Rs.65 per hectare). Other states which invested less than Rs.100 per hectare during 8th Plan period are Tamil Nadu, Assam, Rajasthan and West Bengal.

Union government spent Rs.63 per hectare of net sown area of the country during 5th Plan, which reduced to Rs.34 during 6th Plan and Rs.18 during 7th Plan. The amount spent on agricultural infrastructure during the 1990s was less than Rs.10 per hectare of area.

Per hectare capital expenditure for agriculture in small size north east states remained higher than national average. As against the national average of Rs.187 to 311 during different Plans, capital outlay on agriculture in north east states ranged between Rs.239 to 1744.

Table 4.3:
Capital expenditure per hectare of net sown area at constant prices, 1974-75 to 1996-97

Rupees per year

States	1974-75 to 1978-79	1980-81 To 1984-85	1985-86 to 1989-90	1990-91 and 1991-92	1992-93 to 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Andhra Pradesh	182	147	142	113	174
Assam	163	190	197	205	122
Bihar	196	232	227	139	79
Gujarat	246	162	128	243	179
Haryana	211	219	151	117	215
Himachal Pradesh	420	335	277	267	249
Jammu & Kashmir	1563	1072	1060	1405	1176
Karnataka	168	130	92	107	156
Kerala	362	302	229	264	282
Madhya Pradesh	99	117	101	92	65
Maharashtra	399	328	304	295	275
Orissa	198	216	171	160	137
Punjab	853	713	355	128	618
Rajasthan	91	76	57	60	80
Tamil Nadu	149	89	80	91	73
Uttar Pradesh	337	363	243	292	228
West Bengal	176	115	89	92	98
Goa, Daman & Diu	1838	1355	1324	2112	1423
Arunachal Pradesh	728	1107	1107	1457	1514
Manipur	1420	1272	1121	1627	1170
Meghalaya	417	408	418	643	706
Mizoram	1690	1399	1573	1705	1744
Nagaland	876	913	733	581	239
Sikkim	542	524	521	646	504
Tripura	743	1138	1295	1372	796
Union Government	63	34	18	7	9
All India.	311	258	197	187	188

Variations in annual expenditure incurred on capital formation in agriculture by different states, union government and for the whole country can be seen from the graphs presented in Figure 4.1.

The annual series show that there was no consistent trend in capital expenditure for agriculture in most of the states. In Andhra Pradesh, per hectare capital expenditure in different years varied between Rs.90 and Rs.286 at 1980-81 prices. In Tamil Nadu, since 1978-79, state invested between Rs.67 and 112 per hectare of new sown area. In Kerala public investment in agriculture followed declining trend since 1977-78, which dipped to lowest level in 1987-88, and increased thereafter. In Karnataka the series shows fall during 1980s, and rising trend during 1990s. Maharashtra shows slowly declining trend with moderate fluctuations. There was cyclical pattern of public investment in agriculture in Gujarat, Rajasthan and Uttar Pradesh.

There were two distinct patterns in Bihar - moderately rising trend since 1986-87 and very sharp fall thereafter almost in each successive year. Madhya Pradesh has also been spending lesser resources for farm infrastructure after 1984-85. Capital expenditure on agriculture by West Bengal followed declining trend during 1977-78 to 1984-85 and thereafter showed cyclical pattern with small growth. Agricultural investment by state of Orissa experienced rising phase during 1975-76 to 1980-81 and declining trend in the subsequent period. Punjab shows steep fall in capital outlay after 1986-87. After remaining at a low level for five years public investment started improving after 1992-93. In Haryana, the pattern has been cyclical with no visible trend. The cyclical pattern witnessed in Himachal Pradesh moved in downward direction. In J&K, capital outlay on agriculture showed steady decline between 1978-79 and 1984-85 and steady increase during 1986-87 to 1992-93. In Assam there has been a sharp fall in resources allocated for agricultural infrastructure after 1992-93.

In north-east states the pattern has been generally cyclical. In Nagaland, the trend shows sharp downward movement after 1980-81 whereas Meghalaya witnessed rise during the last 10 years. There were violent year to year fluctuations in Mizoram and Sikkim. Public investment in Arunachal Pradesh showed steep increase till 1979-80 and moderate growth thereafter. Manipur witnessed rise in public investment after 1992-93.

The sum of public investment in agriculture by all states and the union government per hectare of net sown area of the country was Rs.412 during 1975-76 which dropped to below 300 in the next 3 years. Again it increased to Rs.342 during 1979-80 and followed steep fall subsequently till 1990-91 when it reached to level of Rs.160. In the subsequent six years per hectare capital expenditure in agriculture moved between Rs.158 - 218.

Fig.4.1 Per hectare public sector capital expenditure on agriculture (At 1980-81 prices)

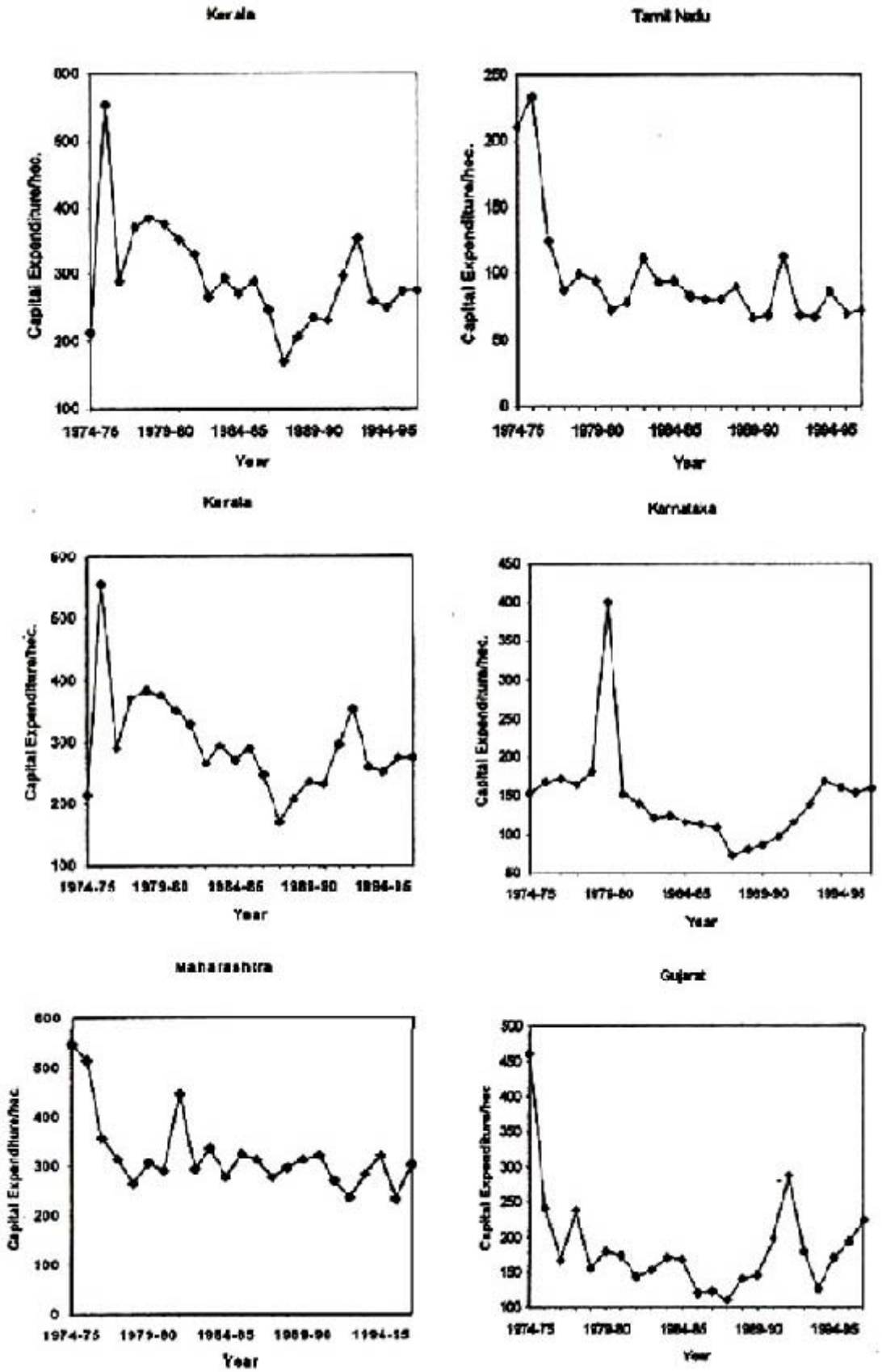


Fig.4.1 Per hectare public sector capital expenditure on agriculture (At 1980-81 prices)

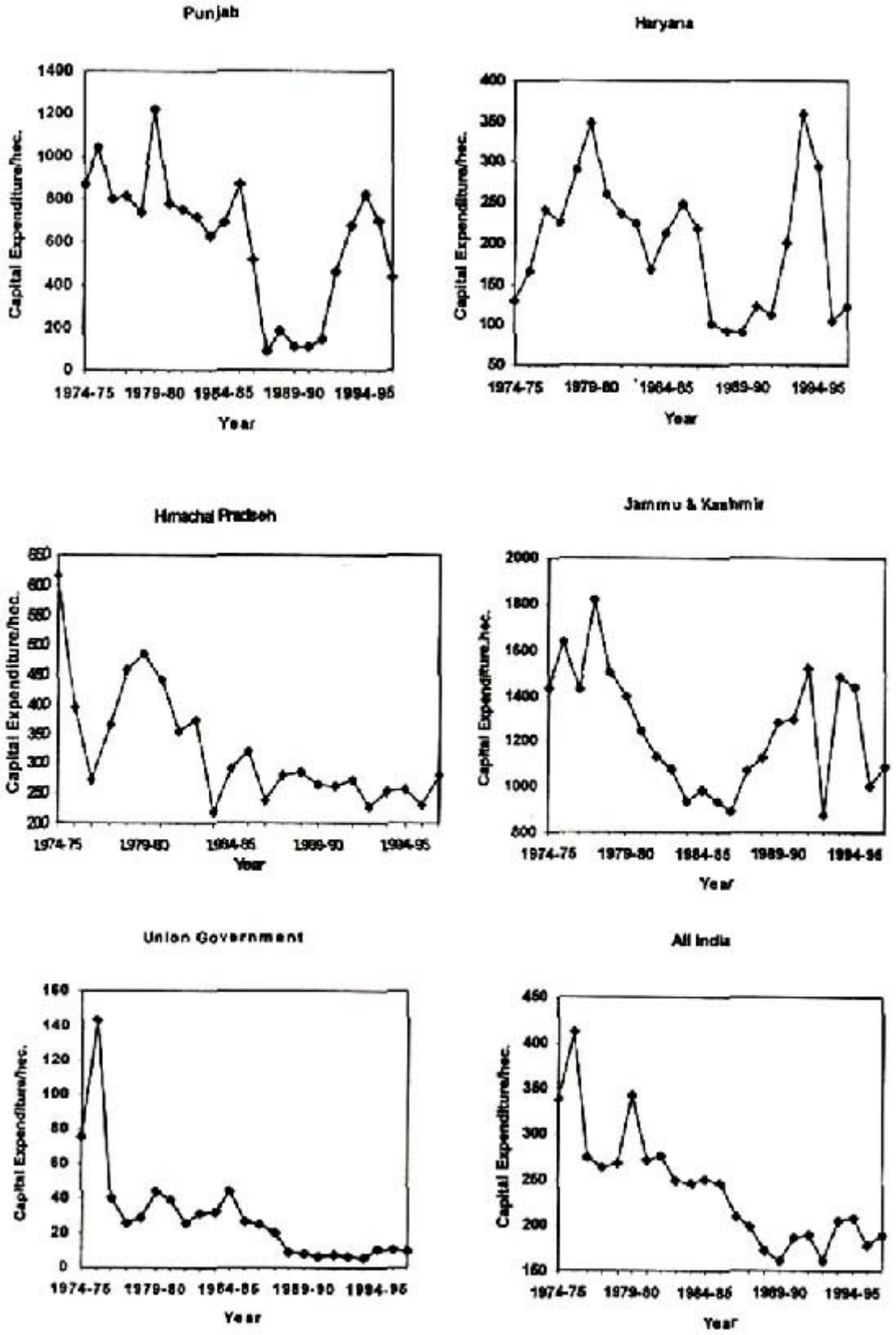


Fig.4.1 Per hectare public sector capital expenditure on agriculture (At 1980-81 prices)

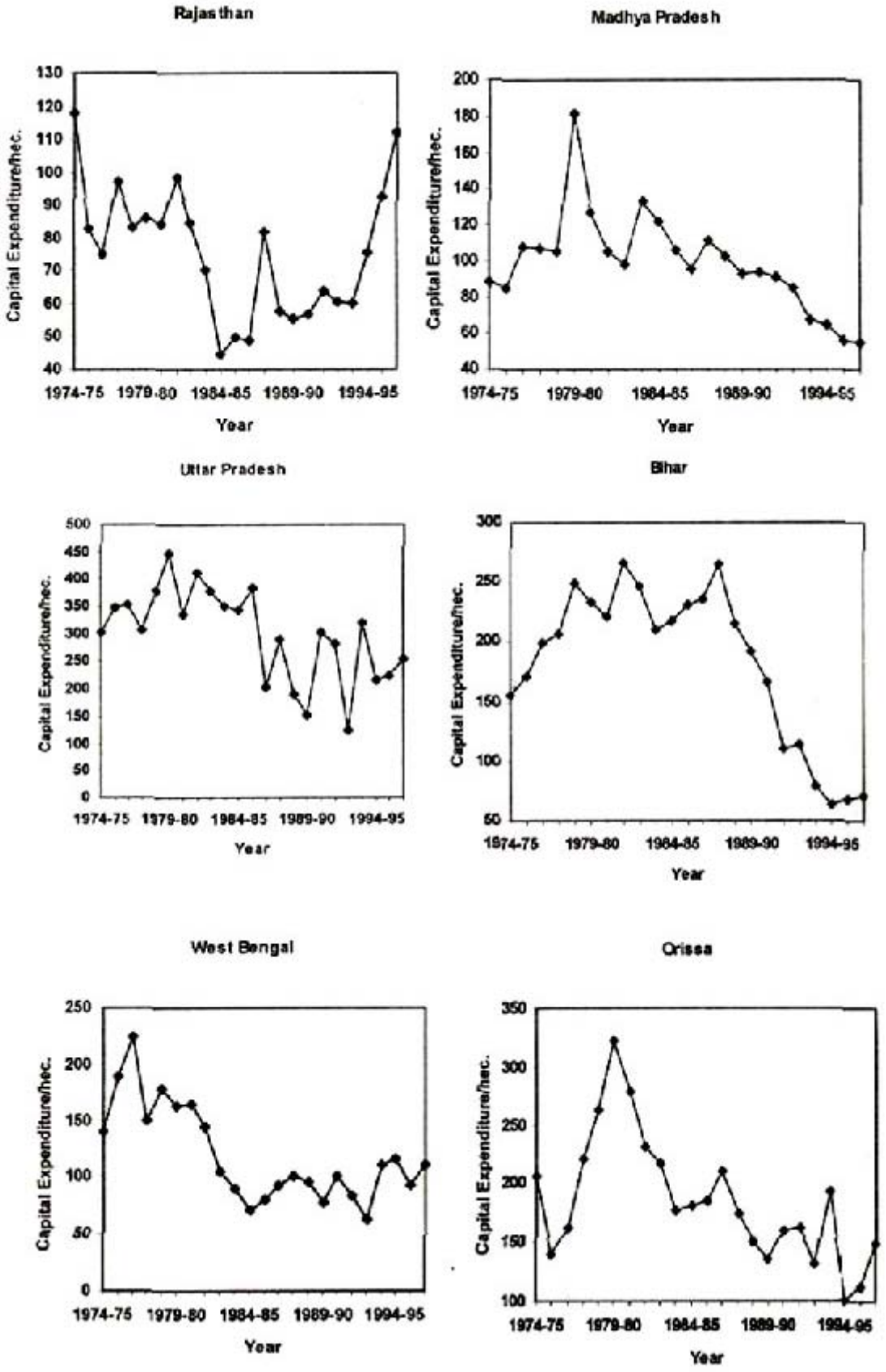


Fig.4.1 Per hectare public sector capital expenditure on agriculture (At 1980-81 prices)

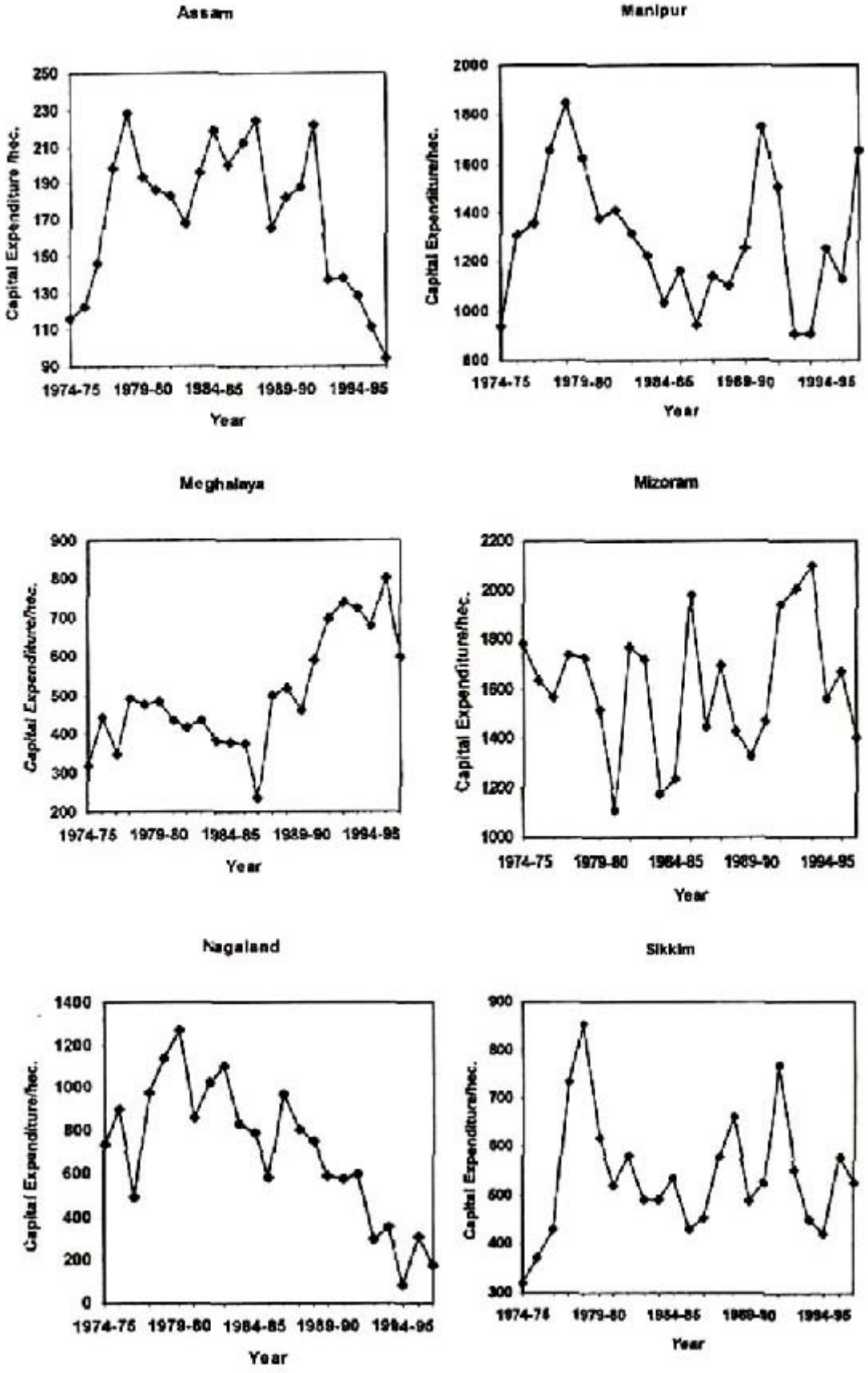
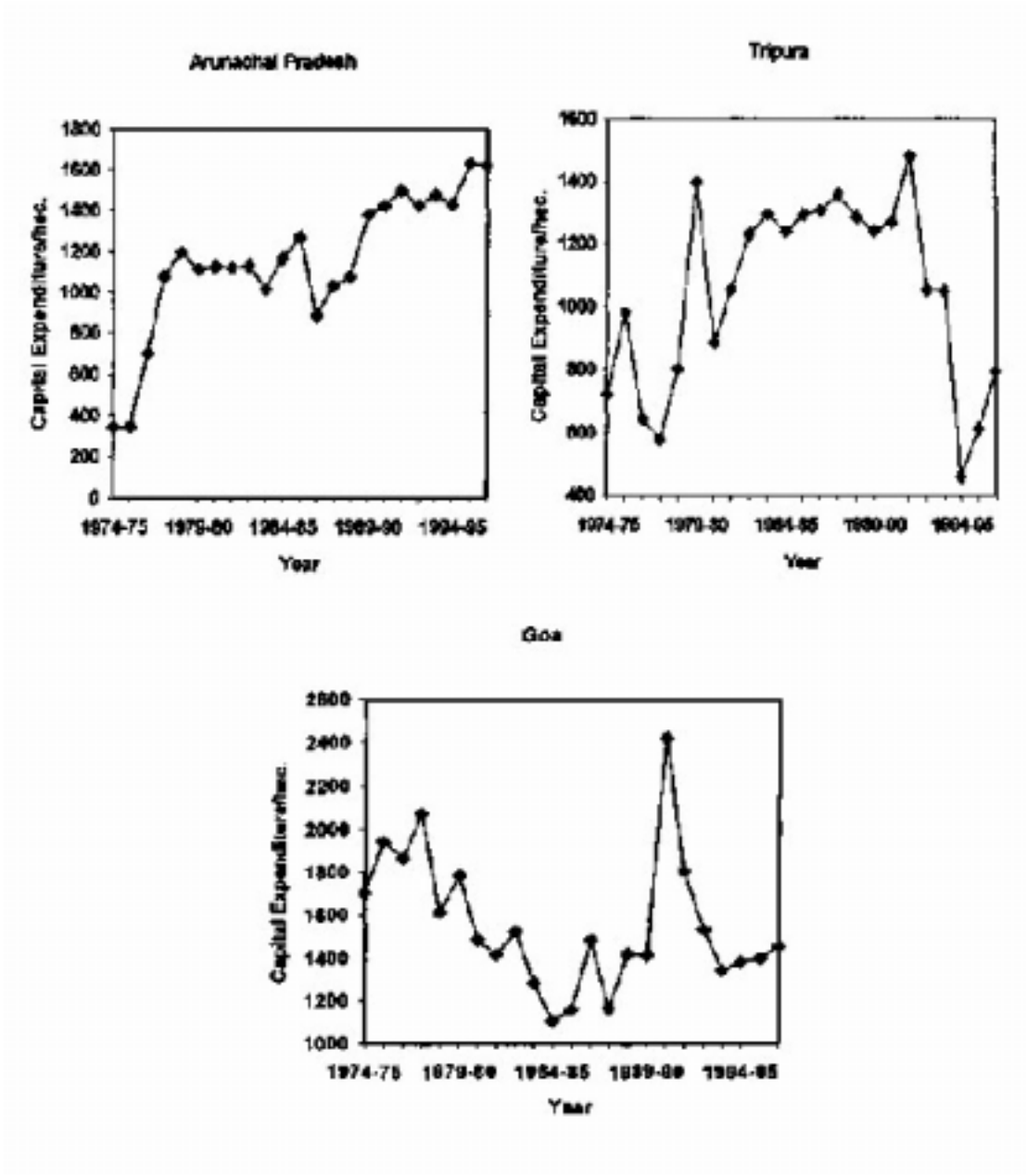


Fig.4.1 Per hectare public sector capital expenditure on agriculture (At 1980-81 prices)



Annual average of the cumulative capital expenditure on agriculture during 1974-75 to 1996-97 and growth rates in the same for each state are presented in Table 4.4. Among major states annual capital expenditure during the past over two decades was highest in Jammu & Kashmir (Rs.1242/hectare) which was far ahead of other states. Punjab turned out to be second highest state with annual outlay of Rs.616 at 1980-81 prices. Himachal Pradesh and Maharashtra occupied third position with annual public investment of Rs.323. Rajasthan, Tamil Nadu and Madhya Pradesh invested less than one hundred rupees per hectare of agricultural area during the past over two decades.

Table 4.4:
Average capital expenditure on agriculture during 1974-75 to 1996-97 at 1980-81 prices per hectare of net sown area

State	Annual expenditure	Growth rate %/year
Andhra Pradesh	160	-0.78
Assam	172	-0.98
Bihar	182	-4.78
Gujarat	186	-1.16
Haryana	198	-2.05
Himachal Pradesh	323	-2.99
Jammu & Kashmir	1242	-1.17
Karnataka	146	-1.66
Kerala	295	-1.56
Madhya Pradesh	99	-2.57
Maharashtra	323	-1.87
Orissa	185	-2.57
Punjab	616	-5.39
Rajasthan	76	-1.22
Tamil Nadu	97	-3.25
Uttar Pradesh	299	-2.80
West Bengal	119	-3.39
Goa, Daman & Diu	1554	-0.90
Arunachal Pradesh	1148	4.57
Manipur	1295	-0.61
Meghalaya	500	2.94
Mizoram	1606	0.21
Nagaland	702	-6.90
Sikkim	537	0.42
Tripura	1043	0.31
Union Government	29	-11.16
All India	239	-3.16

Note: Growth rates based on semi log trend.

The general perception is that the north east states are not given adequate attention in allocation of development resources because of which their level of economic development is low. The sum of capital expenditure on agriculture during past four Five Year Plans dispel this notion. As against the national average of Rs.239, per hectare capital expenditure on agriculture varied between Rs.500 to 1606 in the north-east states - Meghalaya being at the bottom and Mizoram at the top.

All major states and some of the small states show declining trends in the resources spent for infrastructure for agriculture (Table 4.4). Among major states the rate of decline has been highest in Punjab followed by Bihar. At the country level the series declined annually by 3.16 percent over the choosen period.

4.3 Share of Public Investment in NSDP

Proportion of net state domestic product in agriculture spent on capital formation in agriculture for each state is shown in Table 4.5 while the share in total NSDP is shown in Table 4.6.

Table 4.5 :
Capital expenditure on agriculture and related heads as per cent of NSDP Agriculture at current prices

States	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 and 1991-92	1992-93 to 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Andhra Pradesh	5.58	5.15	5.23	3.01	4.19
Assam	3.27	4.66	4.93	4.87	2.52
Bihar	4.42	6.40	5.88	3.27	1.84
Gujarat	8.86	6.25	6.41	10.17	6.38
Haryana	4.36	5.36	3.61	2.05	3.45
Himachal Pradesh	7.10	7.96	7.35	5.63	6.84
Jammu & Kashmir	25.82	19.80	23.14	27.76	20.52
Karnataka	6.59	5.91	4.51	4.10	5.55
Kerala	4.89	5.19	4.40	4.04	3.88
Madhya Pradesh	5.38	8.17	6.90	5.14	3.41
Maharashtra	16.84	18.12	16.66	13.33	9.69
Orissa	6.64	8.28	7.67	7.89	6.57
Punjab	13.49	14.36	6.16	1.92	8.11
Rajasthan	4.75	5.27	4.36	3.40	4.56
Tamil Nadu	3.79	3.05	2.58	2.62	1.81
Uttar Pradesh	8.08	10.27	6.90	6.70	5.04
West Bengal	2.78	2.17	1.66	1.38	1.40
Goa, Daman & Diu	44.52	36.87	41.12	51.93	39.88
Arunachal Pradesh	31.43	3,1.54	34.21	37.21	37.68
Manipur	22.18	18.79	17.41	23.93	16.60
Meghalaya	8.74	8.60	8.57	17.26	19.05
Mizoram		65.90	34.27	32.00	25.04
Nagaland	30.21	46.38	33.48	19.25	6.08
Sikkim		16.08	15.30	18.34	11.63
Tripura	10.40	25.15	30.58	28.49	18.17
All India	9.22	9.55	7.40	5.82	5.40

At all India level, 9.22 percent of net domestic product (NDP) from agriculture sector was invested for capital formation in agriculture by public sector during the first five years of decade of 1980s. However, during the second half of 1980s public resources spent for agricultural infrastructure

declined to 7.40 percent of NDP from agriculture. The decline continued during 1990s and current share of resources for capital formation is little more than 1/20th of the sectoral output.

Union government's contribution to capital formation in agriculture constituted about 1.80 percent of NDP from agriculture during late 1970s. The contribution has dwindled to 0.25 percent during the 1990s.

Among major states capital outlay on agriculture in J&K corresponds to about 1/4th to 1/5th of NSDP agriculture in different plan periods which is the highest. Among the remaining major states Maharashtra spent highest proportion of NSDP agriculture on agricultural infrastructure during 1974-75 to 1996-97. Though Punjab invested highest in agriculture capital on per hectare basis after J&K among major states, it did not occupy same position in respect of percent of NSDP agriculture spent on infrastructure.

Besides Maharashtra, Punjab and Jammu and Kashmir, agricultural investments on public account during 5th Plan exceeded 8 per cent of NSDP in states of Uttar Pradesh and Gujarat (Table 4.5). Assam, Bihar, Haryana, Kerala, Rajasthan, Tamil Nadu and West Bengal invested less than 5 percent of agricultural NSDP for capital formation in agriculture during 5th Plan. West Bengal remained at the bottom throughout in respect of agricultural investment.

In Bihar, share of public investment in agricultural NSDP dropped from around 6 percent during 1980s to less than 2 percent during 8th plan. Though Haryana is agriculturally progressive state, its allocation of NSDP agriculture to farm investment remained lower than the national average in percent term.

The information on percent of total NSDP spent for agricultural infrastructure is presented in Table 4.6. For the country as a whole, 4 percent of national income was spent for infrastructure development for agriculture sector during 5th Plan period. This share kept falling over time and during 8th Plan period less than one and a half percent of national income was ploughed back for capital formation in agriculture.

Share of each state and union government in All India capital expenditure on agriculture is given in Appendix Table 4.1.

Table 4.6:
Capital expenditure on agriculture and related heads as percent of NSDP total at current prices

States	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 and 1991-92	1992-93 To 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Andhra Pradesh	2.61	2.15	1.83	1.09	1.39
Assam	1.72	1.98	1.88	1.64	0.99
Bihar	2.25	2.74	2.45	1.31	0.74
Gujarat	3.19	2.23	1.71	2.69	1.53
Haryana	2.51	2.63	1.53	0.91	1.46
Himachal Pradesh	3.15	2.75	2.20	1.67	1.50
Jammu & Kashmir	12.45	7.35	7.72	9.96	8.01
Karnataka	2.93	2.38	1.58	1.42	1.91
Kerala	2.00	1.77	1.36	1.30	1.16
Madhya Pradesh	2.77	3.38	2.73	1.96	1.27
Maharashtra	4.82	4.16	3.46	2.52	1.88
Orissa	3.83	3.94	3.09	2.72	2.16
Punjab	6.91	6.69	2.76	0.87	3.65
Rajasthan	2.65	2.65	1.86	1.49	1.96 |
Tamil Nadu	1.21	0.74	0.55	0.51	0.36 !
Uttar Pradesh	4.24	4.72	2.86	2.81	2.21
West Bengal	1.06	0.63	0.48	0.43	0.45
Goa, Daman & Diu	8.47	5.95	6.01	7.38	4.26
Arunachal Pradesh	12.43	11.27	12.86	12.52	10.96
Manipur	12.20	8.62	6.93	8.48	5.90
Meghalaya	2.40	4.40	4.03	4.70	4.69
Mizoram		14.05	9.93	9.18	7.87
Nagaland	10.97	12.37	8.38	5.18	1.67
Sikkim		8.14	7.49	8.20	5.74
Tripura	6.60	11.07	12.06	11.21	6.70
Union Government	0.79	0.49	0.22	0.07	0.08
All India	4.06	3.56	2.48	1.92	1.44

4.4 Composition of Public Investment

Distribution of total capital expenditure on agriculture over important heads at 1980-81 prices is shown in Table 4.7. Investment in major and medium irrigation projects continued as the dominant item of capital expenditure on agriculture. Annual expenditure under this head at 1980-81 prices was around Rs.1350 crore during 5th Plan and Rs.1335 crore during 6th Plan periods. The expenditure declined to Rs.1084 crore during Seventh Plan period and further to Rs.989 crores during 8th plan period. Food storage, warehousing and agriculture markets remained the second most important item of public investment in agriculture. Annual expenditure on this head was Rs.1266 crore during 1974-75 to 1978-79, which dropped to Rs.720 crore during 8th Plan period. Likewise, share of storage and warehousing constituted about 29 percent of total capital expenditure on agriculture during 5th and 6th Plans which declined to 25 percent during the 7th Plan and again increased to 27 percent during the 8th Plan period. On the other hand, share of major and medium irrigation increased from 31 percent during 5th Plan to 37 percent during the second half of 1980s and initial years of 1990s. During 1992-93 to 1996-97, major and medium irrigation projects received 37 percent of total capital expenditure on agriculture. Since 1980-81, major irrigation and food storage and warehouses accounted for around 65 percent of capital expenditure on agriculture.

Table 4.7:
Headwise distribution of annual capital expenditure on agriculture at 1980-81 prices.

Rupees: Crore

Heads	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 to 1991-92	1992-93 To 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Crop husbandry	668	251	91	25	24
Soil and water conservation	84	93	53	19	39
Animal husbandry	12	8	6	6	6
Dairy development	74	13	10	6	4
Fishery	9	14	10	9	10
Forestry and wildlife	32	38	44	46	44
Food storage/warehousing	1266	1040	675	738	720
Agricultural research and education	1	1	4	6	2
Agricultural financial institutions	2	13	4	6	38
Cooperation	216	187	101	64	60
Other agricultural programmes	18	40	15	15	5
Other rural development programmes	2	13	18	46	38
Hill areas	58	77	52	34	31
North east areas	--	--	27	57	54
Other special area programmes	--	--	23	13	55
Major irrigation	1350	1335	1084	1038	989
Minor irrigation	143	123	163	164	192
Command area development	0	0	15	28	28
Flood control projects	0	0	46	75	64
Rural electrification	7	9	10	44	44
Fertilizer industry	266	130	71	21	19
District and other roads	168	251	233	193	200

Crop husbandry was third important item of capital expenditure during 1974-75 to 1978-79 with about 15 percent share in total capital expenditure on agriculture. Its importance started diminishing subsequently. Investment in district and other rural roads with an investment of around Rs.200 crore turned out to be the third most important item during 7th and 8th Plan periods. Expenditure for capital formation in rural electrification remained below Rs.10 crore till 1989-90. During the 1990s rural electrification received investment of Rs.44 crore per year at 1980-81 prices. Importance accorded to create infrastructure for dairy development declined sharply after 5th plan period. Public capital invested in fertilizer industry was around Rs.266 crore per year during 5th plan, Rs.130 crore during

6th plan and Rs.71 crore during 7th plan. The annual investment in fertiliser industry declined to around Rs.20 crore during the 1990s.

Combined capital expenditure on hill and north-east areas and other special area programmes has been steadily increasing despite the decline in overall capital expenditure on agriculture.

4.5 Comparison with the C.S.O Series

The CSO series on public investment in agriculture has been narrow as it does not include investment in several items of infrastructure meant for agriculture sector. About 90 percent of the CSO series is reported to consist of investment in major and medium irrigation (Hanumantha Rao, 1997). The present study was undertaken mainly to construct a new series of public investment that includes all important investments having both direct and indirect bearing on agriculture.

The series on public investment in agriculture as per CSO and according to broad coverage are presented in Table 4.8 at current prices since 1974-75. During the initial two years, the CSO investment constituted less than 1/4th of the broad investment in agriculture. The ratio of the CSO series to broad series in the subsequent 20 years varied between 44 to 59 percent.

We have also examined how much of total investment under each series has been allocated to irrigation development consisting of major, medium and minor irrigation works, command area development and flood control. In most of the years, capital expenditure under the irrigation head comprise around 90 percent of the public investment in agriculture as per CSO. In a few years, investment under irrigation head even exceeded the investment reported by CSO. Total for the last two decades reveals that investment in irrigation and allied heads was about 95 percent of the public investment in agriculture reported by CSO

The magnitude of two series at 1980-81 prices is presented in Table 4.9. Barring the year 1974-75 and 1975-76 the CSO series vary between 36 to 61 percent of the broad series compiled in this study. The total of last two decades, i.e. the period between 1976-77 to 1995-96 shows that public investment reported by CSO covers only 48 percent of the total public investment channelled to agriculture sector. Conversely, CSO series excludes 52 percent of public sector expenditure meant for capital formation in agriculture.

Table 4.8:
Public sector capital expenditure in agriculture in relation to capital formation reported by the CSO, at current prices. (*Rs. Crore)*

Year	Capital expenditure as per our (broad) series		Gross capita formation as per CSO	(4) as per cent of (2)	(3) as percent of (2)	(3) as Per cent of (4)
	Total	Irrigation and flood control				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1974-75	2384	555	591	25	23	94
1975-76	3254	670	718	22	21	93
1976-77	2314	917	1013	44	40	91
1977-78	2364	1131	1206	51	48	94
1978-79	2626	1286	1391	53	49	92
1979-80	3619	1462	1618	45	40	90
1980-81	3775	1454	1892	50	39	77
1981-82	4427	1813	2042	46	41	89
1982-83	4705	1898	2270	48	40	84
1983-84	5177	2123	2424	47	41	88
1984-85	5899	2333	2679	45	40	87
1985-86	6496	2524	2811	43	39	90
1986-87	6168	2718	2936	48	44	93
1987-88	6076	2805	3383	56	46	83
1988-89	5867	3355	3442	59	57	97
1989-90	6122	3416	3354	55	56	102
1990-91	7473	3658	3628	49	49	101
1991-92	8310	4113	3653	44	49	113
1992-93	8061	3977	4175	52	49	95
1993-94	11569	5252	4926	43	45	107
1994-95	13049	6405	6087	47	49	105
1995-96	12429	5982	6557	53	48	91
1996-97	12326	6946				
For the whole Period	132165	59848	62796	48	45	95

When we look at the behaviour of the two series, at real prices, it is observed that public investment in agriculture based on CSO was rising till 1980-81 and followed a declining trend thereafter. When the first two years (1974-75 and 1975-76) are taken out, public investment in agriculture based on broad

series reached peak level of Rs. 4747 crore in 1979-80, which is one year before the peak of CSO series. Thereafter, broad series also indicate declining trend like the CSO series. Thus, it is not correct to say that public investment for agriculture, which includes all major heads like rural It would be interesting to find whether public investment in irrigation has declined at a different rate compared to the public investment in other agricultural infrastructure. This has been done by computing trend growth rates in CSO series and capital expenditure on irrigation and allied heads and other heads as included in the broad series. Some inference regarding this can also be drawn by looking at the behaviour of the two series presented in Fig. 4.2.

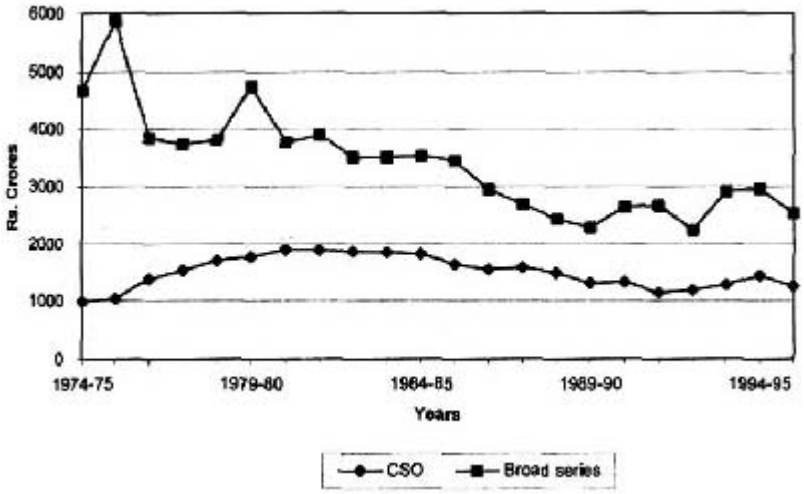
Table 4.9:
Public investment in agriculture according to CSO and broad series and capital expenditure on irrigation and other heads, at 1980-81 prices

Rupees:crore

Year	CSO	Broad Series	(2) as per cent of (3)	Irrigation and allied	Other heads	(5) as per cent of (2)
(1)	(2)	(3)	(4)	(5)		(6)
1974-75	991	4672	21	1087	3586	110
1975-76	1041	5861	18	1207	4654	116
1976-77	1378	3833	36	1519	2314	110
1977-78	1534	3736	41	1787	1949	117
1978-79	1697	3812	45	1867	1945	110
1979-80	1772	4747	37	1917	2829	108
1980-81	1892	3775	50	1454	2321	77
1981-82	1878	3887	48	1592	2295	85
1982-83	1857	3503	53	1413	2089	76
1983-84	1843	3507	53	1438	2069	78
1984-85	1822	3523	52	1394	2130	76
1985-86	1631	3451	47	1341	2110	82
1986-87	1550	2934	53	1293	1641	83
1987-88	1580	2690	59	1242	1448	79
1988-89	1485	2431	61	1390	1041	94
1989-90	1301	2284	57	1274	1009	98
1990-91	1315	2644	50	1294	1350	98
1991-92	1135	2663	43	1318	1345	116
1992-93	1179	2239	53	1105	1134	94
1993-94	1272	2914	44	1323	1591	104
1994-95	1438	2959	49	1452	1506	101
1995-96	1250	2537	49	1221	1316	98
Sum of 1976/77 to 1995/96	30809	4067	48	28634	35433	93

During the period 1974-75 to 1981-82 public investment in agriculture as per the CSO series increased at the trend rate of about 10 percent whereas growth in broad series was negative but non significant. When total capital expenditure on agriculture as per the broad series was divided into two parts, namely expenditure on irrigation and expenditure on other heads, the former showed positive and the latter showed negative growth though both were statistically non significant (Table 4.10).

Fig. 4.2 Public sector investment in agriculture as per CSO and as per the broad series at 1980-81 prices



The growth rates after 1980-81, when CSO series had reached peak, clearly; indicate that investment in other infrastructure has declined at a much faster rate compared to the rate of decline in irrigation infrastructure (see Table 4.10). The rate of decline in other infrastructure during 1981-82 to 1992-9! was 7.23 percent per annum which is more than double the rate of decline in CSO series as well as in capital expenditure on irrigation as per our series. When entire period since 1981-82 is considered, the rate of decline in investment in other heads is 4.21 percent compared to -1.09 percent ii irrigation investments and -3.42 percent in CSO series.

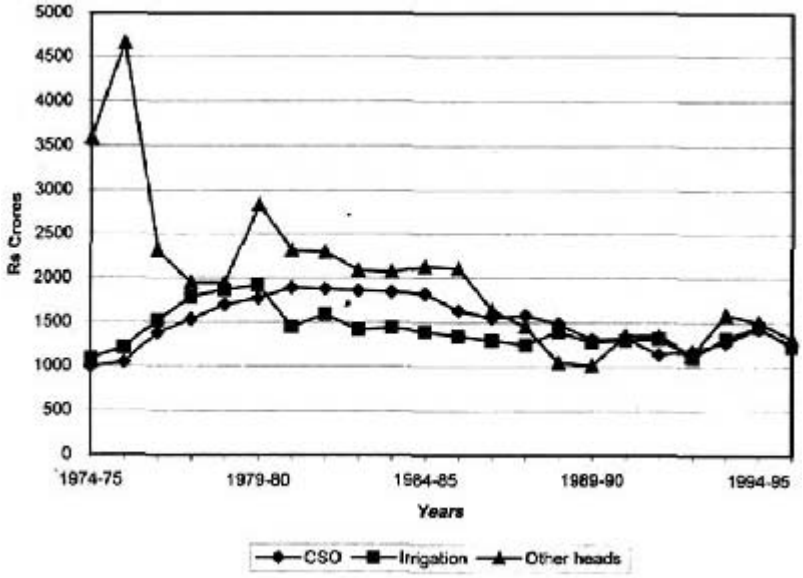
Table 4.10:
Growth rates in public investment based on CSO series and the broad series

Series	1974-75 to 1981-82	1981-82 to 1992-93	1981-82 to 1995-96
1.CSO	9.90	-3.38	-3.42
2. Broad Series:			
a. Total	-3.38NS	-4.81	-2.81
b. Irrigation	5.16NS	-3.38NS	-1.09
c. Other Heads	-7.15NS	-7.23	-4.21

NS - Non significant upto 5% level.

The behaviour of investment series can also be seen from Fig. 4.3. Public sector capital expenditure on the other heads (which include rural roads electrification, marketing, storage, warehousing, fertiliser industry, financial institutions etc.) was higher than capital expenditure on irrigation and allied heads and also higher than the CSO series till 1986-87. The difference was quite large in the initial years and it banished steadily. After 1986-8 investment in other heads fluctuated closely around the CSO series and the series on capital expenditure on irrigation.

Fig. 4.3 Public investment in agriculture as per CSO and capital expenditure on irrigation and other heads at 1980-81 prices



Appendix Table 4.1:
Percent share of different states in All India capital expenditure on agriculture

States	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 and 1991-92	1992-93 to 1996-97
	5th Plan	6th Plan	7th Plan		8th Plan
Andhra Pradesh	4.78	4.43	5.52	4.72	6.65
Assam	1.02	1.43	1.95	2.10	1.20
Bihar	3.90	4.90	6.36	3.98	2.09
Gujarat	5.13	4.31	4.50	8.57	6.43
Haryana	1.81	2.15	1.86	1.55	2.70
Himachal Pradesh	0.53	0.52	0.59	0.58	0.54
Jammu & Kashmir	2.57	2.11	2.86	3.88	3.22
Karnataka	3.93	3.71	3.54	4.26	6.31
Kerala	1.85	1.79	1.85	2.25	2.34
Madhya Pradesh	4.29	6.18	7.18	6.75	4.63
Maharashtra	16.32	16.38	20.19	19.76	18.44
Orissa	2.78	3.58	3.86	3.82	3.21
Punjab	8.12	8.20	5.02	2.05	9.67
Rajasthan	3.11	3.15	3.16	3.61	5.06
Tamil Nadu	2.00	1.45	1.65	1.96	1.60
Uttar Pradesh	13.59	17.27	14.94	19.02	14.89
West Bengal	2.46	1.64	1.76	1.84	2.03
Goa, Daman & Diu	0.57	0.51	0.68	1.07	0.75
Arunachal Pradesh	0.20	0.36	0.65	0.82	0.86
Manipur	0.47	0.48	0.58	0.86	0.63
Meghalaya	0.17	0.22	0.31	0.49	0.53
Mizoram	0.17	0.25	0.37	0.42	0.42
Nagaland	0.28	0.43	0.48	0.42	0.17
Sikkim	0.08	0.12	0.18	0.23	0.18
Tripura	0.42	0.81	1.26	1.38	0.77
Union Government	19.42	13.64	8.68	3.60	4.68

5 PRIVATE INVESTMENT IN AGRICULTURE

Time series information on private fixed capital formation in agriculture at country level is furnished by CSO However, neither CSO nor state level statistical departments provide this information except for one or two states. Some recent studies have used statewise estimates of private investment in agriculture reported in the nation-wide survey All India Debt and Investment Survey 1981-82, brought out by Reserve Bank of India, to find out the determinants of private capital formation (Dhawan and Yadav, 1995; Dhawan, 1996a, 1996b; Dhawan, 1997). Similar nation-wide survey for the year 1991-92 has been carried out by National Sample Survey Organisation of GOI, results of which are presented in the report Household Capital Expenditure During 1.7.91 to 30.6.92 - Debt and Investment Survey, report no. 437. This report has been published in September 1998. There are similarities in the two surveys and the concepts and definitions followed in the two are comparable.

Both these nation-wide surveys provide estimates of fixed capital formation by different categories of households in (i) farm business, (ii) non-farm business and (iii) residential plots and buildings. Information is also available for cultivators and non-cultivator households in rural areas, and self employed and non-self employed households in urban areas.

Using the information available in these two nation-wide surveys, estimates of fixed capital formation in agriculture (FCFA) by private sector have been arrived at by multiplying per households FCFA with the number of households (rural and urban).

5.1 Country Level Estimates of FCFA

Country level estimates of fixed capital formation in agriculture on private account according to the nation wide surveys and according to CSO are presented in Table 5.1.

According to CSO, private investment in agriculture was Rs. 3170 crore during 1981-82 which increased to Rs. 11123 crores during 1991-92. Private fixed investment in agriculture based on the RBI and NSSO survey was Rs. 1445 crore during 1981-82 and Rs. 4801 crore during 1991-92. The private investment according to nation wide surveys was around 46 percent of the CSO estimate. This is surprising because nation wide surveys are reported to be the basis for preparing the CSO estimates.

Table 5.1: Country level estimates of fixed private capital formation ii agriculture at current prices

Rs. crore

Source	1981-82	1991-92
1.CSO	3170	11123
2. Nation wide survey	RBI	N.S.S.O.
All Households	1445	4801
By cultivators	1266 (87.61)*	4213 (87.46)*

* Percent of FCFA by all households.

According to these nation wide surveys about 87 percent of FCFA cam from cultivator households. These estimates at state level show that in son-states non-cultivating households contributed as high as 25 percent of fixed investment in agriculture.

Similarly, in some states urban households contributed about 23 percent total private fixed investment in agriculture. Due to large contributions Made by rural non-cultivating households and urban households to FCFA in sort states, the statewise estimates of FCFA were prepared by taking in

account the contribution of all kind of households - rather than estimating the FCFA based on the contribution by cultivator households alone.

5.2 Statewise Estimates of FCFA

Statewise estimates of FCFA on private account at two points of time as revealed by RBI and NSSO surveys are presented in Table 5.2. To make inter state comparison, FCFA has been computed on per hectare basis During 1981-82, Punjab ranked number one with private investments of Rs. 262 per hectare of net sown area at 1980-81 prices. Kerala ranked second and Haryana occupied the third place. Eastern states and Madhya Pradesh were at the bottom with per hectare investment of Rs. 23 in Orissa, Rs. 40-43 in Bihar and Assam, and around Rs. 51 in Madhya Pradesh and West Bengal.

During the 10 years, from 1981-82 to 1991-92, private investment in Orissa Bihar and Assam further deteriorated and ranged between Rs. 21-38 1991-92. Madhya Pradesh recorded highest growth in private FCFA during this period, which has raised per hectare investment from Rs. 51 in 1981-82 to Rs.138 in 1991-92. In Rajasthan, Karnataka and Himachal Pradesh annual growth rate exceeded 8 per cent. Tamil Nadu and Maharashtra also achieved impressive growth in fixed capital formation in agriculture.

In Jammu & Kashmir, Assam and Punjab private investment in fixed assets in agriculture followed sharp decline. Private investments in agriculture awfully low in the three eastern states. Compared to all India average Rs. 126 per hectare of net sown area, private investment in Orissa, Assam and Bihar ranged between Rs. 21-38 while in West Bengal it was Rs. 65

Table 5.2: Statewise total and per hectare private fixed capital formation in agriculture

State	Total: at current prices Rs. Lakh		Per ha: at constant prices Rs./ha. of NSA	
	1981-82	1991-92	1981-82	1991-92
Andhra Pradesh	11039	28283	86	96
Assam	1245	1886	40	26
Bihar	3940	7889	43	38
Gujarat	9820	20050	87	78
Haryana	8207	16890	195	176
Himachal Pradesh	697	3610	104	229
Jammu & Kashmir	837	1265	100	63
Karnataka	9853	53452	81	184
Kerala	5373	15746	210	257
Madhya Pradesh	11155	71588	51	138
Maharashtra	16695	65916	78	138
Orissa	1613	3703	23	21
Punjab	12854	19804	262	173
Rajasthan	9895	49878	56	112
Tamil Nadu	8926	38202	133	245
Uttar Pradesh	26663	68484	132	145
West Bengal	3351	9445	52	65
Goa, Daman & Diu		613		163
Arunachal Pradesh		903		222
Manipur		660		173
Meghalaya		194		35
Mizoram		154		87
Nagaland		903		174
Sikkim		15		6
Tripura		103		14
India	144498	480138	89	126

Among the smaller states, per hectare private capital formation in agriculture was merely Rs. 6 in Sikkim, Rs. 14 in Tripura and Rs. 35 in Meghalaya. Per hectare private investment in Arunachal Pradesh, Manipur and Nagaland varied between Rs. 173 to Rs. 222.

5.3 Complementarity Between Public and Private Investments

Several research studies have examined the relationship between public and private investments using time series data at country level. All these studies have used raw time series which can give spurious relationship if assumption of stationarity of the series is not satisfied (Granger and Newbold, 1974). Thus, in order to establish true relationship between the time series variables one must satisfy stationarity of these variables (Granger and Newbold, 1977). In this study we have proceeded by applying Augmented Dicky Fuller Test (ADF) to test the time series on public and private investment for their stationarity. This test examines the null hypothesis of non stationarity against the hypothesis of stationarity. The results are presented in Table 5.3.

The series have been tested for stationarity for three periods viz. 1960-61 to 1996-97, 1960-61 to 1980-81 and 1981-82 to 1996-97. The reason for dividing entire period into two sub periods was the turnaround in public sector investments after 1980-81; the first sub period represents rising phase and the second sub period represents declining phase of public sector investments (see Figure 1.1 in Ch.1). The results show that raw series (termed as Level) was not stationary as the estimated values of both Dicky Fuller (DF) as well as Augmented Dicky Fuller (ADF) statistics are higher than the critical values. The stationarity was further tested by applying different lags upto 4 years. The series at first difference turned out to be stationary as DF and ADF statistics were lower than the critical values.

Table 5.3: Test of stationarity of time series on public and private investments in agriculture at 1980-81 prices

Sample Period	Variable	Level		Difference		Critical value 95%
		DF statistic	ADF Statistic	DF statistic	ADF statistic	
1960/61 to 1996/97	Public investment	-0.379	-0.769	-3.80	-2.74	-2.95
	Private investment	-1.324	-0.319	-6.49	-4.50	-2.95
1960/61 to 1980/81	Public investment	-0.973	-0.527	-3.78	-3.56	-3.05
	Private investment	-1.466	-1.011	-4.72	-4.32	-3.05
1981/82 to 1996/97	Public investment	-1.940	-2.200	-3.87	-3.09	-3.73
	Private investment	-1.640	-1.140	-6.20	-4.21	-3.73

After having established that the public as well as private investments are 1(1) i.e. each series is integrated of order 1, the long run relationship between the two series is established through the estimation of cointegration between the two series. This is estimated using the Engle-Granger two step procedure (Engle and Granger, 1987). The first step involves fitting ordinary least square to the two series and the estimation of residual term as under:

$$\text{Private investment}_t = b_0 + b_1 \text{Public investment}_{t-1} + \S_t$$
$$\xi_t = \text{Private investment}_t - b_0 - b_1 \text{Public investment}_{t-1}$$

The second step involves testing the stationarity of the error term ξ t- If ξ t is stationary, then the two series are cointegrated otherwise they do not have any long term relationship.

The results of Unit root test which test the null hypothesis that the error terms are non stationary are presented in Table 5.4. The unit root values in all the cases are higher than the critical values which implies that the £t is non stationery. In other words, this implies that there is no long term relationship between the two series. Thus, it can be concluded that positive or negative association observed by various researchers between the raw series of public and private investments in different periods is spurious as there is no true long term relationship between the two series.

Table 5.4:
Unit root test of series on residuals derived from regression equation on public and private investments in agriculture at 1980-81 prices

Sample period	Unit root values for		
	DF statistic	ADF statistic	Critical value 95%
1960/61 to 1996/97	0.534	0.518	-3.52
1960/61 to 1980/81	-2.940	-2.280	-3.74
1981/82 to 1996/97	-0.807	-1.520	-3.89

5.4 Determinants of Private Investment

Both the public and private investments at country level have moved on a rising trend till early 1980s. Based on this, quite a few studies concluded that public investment is the main determinant of private investment in agriculture. However, after 1981-82 the two series started moving in opposite directions - public investment started moving downward whereas private investment continued to show upward trend. Accordingly, during post 1980 period the impact of public sector capital formation on the private capital formation is either non-significant or negative - which is somewhat difficult to interpret. It has been suggested that because of restrictive coverage of CSO series the actual impact of public investment on private investment may not be revealed. Thus, if one is interested to capture actual impact of public investment on private investment, one should broaden the coverage of public investment by accounting for all important infrastructure directly and indirectly benefiting agriculture.

We have analysed the impact of public investment on private investment in agriculture by using our own broad series on public investment and by using CSO series on the same at the national level. The national level results have been further verified by using statewise data for 1981-82 and 1991-92 at 1980-81 prices.

It was hypothesised that private investment in agriculture is affected by (i) public investments, (ii) institutional credit provided for medium and long term purposes i.e. loans for creation of asset and (iii) terms of trade (TOT) for agriculture. Among these three variables, terms of trade for agriculture is measured in several ways. There are mainly three kinds of sectoral terms of trade between agriculture and non agriculture sectors available in literature. These are: one, ratio of implicit price deflator for agriculture to non agriculture sector; two, ratio of price index of agricultural products to price index of manufactured products, as published in Economic Survey (Government of India); and three, ratio of prices received to prices paid by agriculture sector i.e barter terms of trade. Out of the three measures of terms of trade between agriculture and non agriculture the index based on barter terms of trade prepared by the Commission on Agricultural Costs and Prices (CACP) GOI, was used to study the impact of TOT on the private capital formation.

The association between private investment in agriculture and other relevant variables at all India level for the period 1981-82 to 1996-97 can be seen from the correlation coefficients presented in Table 5.5 (the raw data is given in Appendix 5.1). The results are for one-year lag in public investment. One year lag was also tried for terms of trade as well as for institutional finance for

agriculture and it showed lower correlation with the private investment compared to the series without lag.

Private investment in agriculture shows significant positive association with institutional advances for term loans for agriculture as well as with the terms of trade for agriculture. Correlation between public investment series of CSO and the private investment was negative and statistically significant. The broad series on public capital expenditure on agriculture also exhibits negative and significant correlation with private investment.

Table 5.5:
Correlation between private investment in agriculture and other relevant variables 1980-81 to 1996-97

	Private investment	Public investment CSO	Public investment Broad series	Terms of trade	Institutional advances to agriculture
Private investment in agriculture	1.000	-0.779	-0.645	0.665	0.656
Public investment CSO		1.000	0.801	-0.753	-0.596
Public investment broad series			1.000	-0.512	-0.746
Terms of trade				1.000	0.472 NS
Institutional term loan for agriculture					1.000

Note: Absolute value of correlation coefficient above 0.6055 is significant at 1% and the value above 0.482 is significant at 5 % level of significance.

Private investment in agriculture may be simultaneously affected by all the three variables namely institutional borrowing for medium and long term assets and investments, terms of trade for agriculture and public investment. In order to see the effect of these variables on private fixed investment in agriculture, multiple regression analysis was carried out; the results of which are presented below.

a) When CSO series on public investment is used among explanatory variables:

PVTFCA=-2758.0 - 1.306PUBCSO+78.974TOT+0.929 INSTFIN.....5.1
(0.48) (1.351) (1.028) (1.36)
Adj.R^2 =0.592 N=15

PVTFCA= 5142.24 - 1.992 PUBCSO + 0.963 INSTFIN.....5.2
(2.739)* (2.98)* (1.48)
Adj.R^2 = 0.609

PVTFCA=2284.0 - 2t.419PUBCSO+59.342TOT.....5.3
(0.244) (2.31)** (0.642)
Adj.R^2 =0.544

PVTFCA=-11632.0 + 151.01TOT + 1.277 INSTFIN.....5.4
(2.534)** (2.639)** (1.952)***
Adj.R^2 =0.564

PVTFCA=-15819.25 + 224.241 TOT.....5.5 I
(2.688)** (3.332)* I
Adj. R^2 =0.442 I

PVTFCA= 158.17 + 2.122 INSTFIN .....5.6 I
(0.147) (3.243)*
Adj.R^2 =0.388

PVTFCA= 8283.7 -2.954PUBCSO 5.7
(8.63)* (4.811)*
Adj.R^2 =0.581

b) When broad series on public investment is used among explanatory variables

PVTFCA=-11091 - 0.0695 PUBBRSR+148.73 TOT+1.193 INSTFIN..5.8
(1.82)*** (0.143) (2.406)** (1.329)
Adj.R^2 =0.525 N=16

PVTFCA = 2126.73 - 0.365PUBBRSR +1.582 INSTFIN 5.9
(0.725) (0.723) (1.583)
Adj. R^2 = 0.367

PVTFCA =-7690.9 - 0.765PUBBRSR +156.62 TOT.....5.10
(1.091) (1.82)*** (2.158)**
Adj.R^2 = 0.487

PVTFCA = -11632.0+1.582 INSTFIN +151.01 TOT 5.11
(2.534)** (1.952)*** (2.639)**
Adj.R^2 = 0.564

PVTFCA = -15819.2 +224.24 TOT 5.12
(2.688)** (3.32)*
Adj.R^2 = 0.402

PVTFCA =158.166 +2.122 INSTFIN 5.13
(0.147) (3.243)*
Adj.R^2 = 0.388

PVTFCA = 7231.92 - 1.186'PUBBRSR 5.14
(6.637)* (3.266)*
Adj.R^2 = 0.377

where:

PVTFCA = Private fixed capital formation in agriculture (Rs. crore)
PUBCSO = Public investment in agriculture as per the CSO series (Rs. Crore)

TOT = Terms of trade for agriculture (percent of index of prices received by agriculture sector to the index of prices paid by agriculture sector)

INSTFIN = Institutional direct advances to farmers for medium and long term purposes during the year (Rs. crore).

PUBBRSR = Public investment in agriculture as per the broad series.

(Figures in parentheses are 't' values and ***, ** and * indicate the T value is significant at 10, 5 and 1 % level respectively).

All the variables were expressed in 1980-81 prices while TOT was measured with base triennium ending 1971-72=100.

It would be seen from Table 5.5 that different variables used as explanatory variables are having significant correlation among them. Correlation between terms of trade and public investment as per CSO is -0.753 which is quite high. Similarly, the correlation between institutional advances to agriculture and pubic investment as per the broad series is also very high (0.746). This caused multicollinearity problem, which affected significance level of regression coefficients of affected variables. For instance, when all the three variables are considered in the regression equation 5.1 then none of the variables show significant impact on private capital formation in agriculture at country level. However, when each of these variables is used alone as explanatory variable, then impact of each of the three variables turned out to be significant at 1% level (vide equations 5.5 to 5.7). Transformation of variables in log form also did not help in overcoming the problem due to multicollinearity. In this kind of situation it becomes very difficult to estimate precise impact of explanatory variables on dependent variable. Nevertheless, one can have some idea about the nature of relationship between dependent and independent variables by running regressions including different combinations of independent variables. The sets of regression equations 5.1 to 5.7 and 5.8 to 5.14 are an attempt in this direction, to understand the determinants of private investment and how each of these determinants affect the private capital formation.

The above equations show that public sector capital investments based on CSO series as well as that based on broad series did not have positive impact on private investments during the period 1980-81 to 1996-97. Terms of trade for agriculture and institutional credit advanced to farmers for asset building have positive and significant impact on private capital formation in agriculture.

The relationship between public and private investments was further studied using statewise information for the years 1981-82 and 1991-92. It was hypothesised that per hectare private fixed capital formation in agriculture in a state would depend upon public expenditure for capital formation in agriculture and medium and long- term institutional borrowings by farmers. All the three variables were expressed on per hectare basis and at current prices as shown in Appendix Table 5.2. The estimated relationship is given below for 16 major states. The state of Jammu & Kashmir was not considered while estimating the regression equations as it happens to be an outlier with respect to public capital expenditure on agriculture. The estimated results are:

PVTFCA(1981-82)=19.76+0.548INSTFIN+0.1651PUBBRSR(1980-81)..5.15
(1.16) (3.31)* (2.474)**
Adj.R_2 = 0.722 N=16

PVTFCA(1991-92)=129.54+0.232INSTFIN+0.064PUBBRSR(1990-91)..5.16
(1.11) (3.07)* (0.342)
Adj.R_2 = 0.423 N=16

PVTFCA(1991-92)= 159.02 + 0.232 INSTFIN 5.17
(2.09) (3.17)*
Adj.R_2 = 0.376

PVTFCA(1991-92)= 335.1 +0.059 PUBBRSR (1990-91) 5.18
(2.77) (0.25)
Adj.R_2 =- 0.067

The above equations show that during 1981-82, both public sector investments in agriculture as well as institutional term loans to farmers exerted positive and significant impact on private sector capital formation in agriculture. However, during 1991-92 public sector capital expenditure ceased to cause significant influence on private sector capital formation.

The absence of significant impact of public capital expenditure on private investment in agriculture in 1991-92 can be questioned on the ground that one year lag is not justified to realise impact of public sector investment on private investment. In order to examine whether more than 1 year lag in public capital expenditure would have impact on private investment, correlation between two types of investments was estimated by extending the lag. The results are presented in Table 5.6 which show that extending lag period did not improve relationship between private investment during 1991-92 and public investment during the previous years.

Table 5.6:
Correlation between public sector capital outlay and private investment in agriculture in major states

Time lag in public capital expenditure	Private investment during	
	1981-82	1991-92
One year	0.556*	0.070
Two year	0.595*	0.010
Three year	0.580*	0.121
Four year	0.630**	0.107

Note : Based on 16 major states (excluding J&K) * Significant at 5 % level. ** Significant at 1 % level.

The results of regression analysis and correlation analysis show that public sector capital expenditure and institutional term loans for agriculture were the significant determinants of private investment in agriculture during 1981-82. However, public sector investments ceased to cause significant impact on inter state variation in private investment in 1991-92. The statewise results corroborate the country level results which indicated that public investment in agriculture has not been significant determinant of private investment during 1990s.

There is ample evidence to prove that the impact of public investment on private investment is not uniform in the pre 1981-82 and post 1981-82 period. In the pre 1981-82 period public investment has caused favourable impact on private investment which turned out to be negative or non significant during the subsequent period. This raises an important issue that why public investment ceased to be important determinant of private investment after early 1980s?

Based on the results presented in the chapter it can be concluded that the relation or impact of public investment on private investment would vary depending upon the type of public investment in different regional settings. All kind of public investment may not lead to or induce private investment. Some of the private investment in Indian agriculture may be induced by public investment and some may be autonomous. At micro-level there are some areas of investments where private investment can even be a substitute for public investment. Misplaced priorities and leakages in public investments are the other reasons for lack of inducement effect on private investments.

The importance and role of public investment to create infrastructure and to promote long term agricultural growth should not be undermined by lack of complementarity between public and private investment. However, public investment would be effective in playing this role only if it serves the purpose for which it is created. There are instances when huge investment made in infrastructure in

some areas soon ceased to serve its purpose due to lack of maintenance. There is a need to keep the created infrastructure functional so that it serves the intended purpose.

Appendix Table 5.1:
Public and private capital formation in agriculture as per CSO and the broad series and other relevant variables

Unit: Rs. Crore

Year	Investment as per CSO series			Public capital Expenditure: Broad series	Direct institutional term loans to agri.	Terms of trade for agriculture base TE 1971/72=100
	Total	Public	Private			
1981-82	4741	1878	2863	3887	1557	84.7
1982-83	4865	1857	3008	3503	1469	86.3
1983-84	4406	1843	2563	3507	1766	86.0
1984-85	4888	1822	3066	3523	2435	82.4
1985-86	4641	1631	3010	3451	2629	85.3
1986-87	4360	1550	2810	2934	3207	86.9
1987-88	4782	1580	3202	2690	3682	86.2
1988-89	4737	1485	3252	2431	3497	86.5
1989-90	4791	1301	3490	2284	4080	90.0
1990-91	5076	1315	3761	2644	4209	92.7
1991-92	5212	1135	4077	2663	4587	86.6
1992-93	5873	1179	4694	2239	4824	90.9
1993-94	5574	1272	4302	2914	5261	91.7
1994-95	6244	1438	4806	2959	6840	90.3
1995-96	6927	1250	5677	2537	8699	88.9

Note: Investment series is at 1980-81 prices and institutional finance is at current price.
Source: 1. National Accounts Statitics, CSO, various issues.
2. Finance Accounts of Concerned States and Union Government.
3. Report on Currency and Finance, Reserve Bank of India, various issues.
4. Report of the Commission for Agricultural Costs and Prices for 1998-99.

Appendix Table 5.2:
Statewise private and public investment in agriculture and other relevant variables, Rs./hectare

State	Private investment		Public capital expenditure		Institutional term loan	
	1981-82	1991-92	1980-81	1990-91	1981-82	1991-92
Andhra Pradesh	96	261	185	308	68	605
Assam	40	70	187	530	4	295
Bihar	49	105	221	472	30	808
Gujarat	100	214	175	559	52	625
Haryana	153	480	259	347	165	1757
Himachal Pradesh	121	626	443	741	141	1022
Jammu & Kashmir	103	173	1245	3648	34	256
Karnataka	85	503	152	273	44	662
Kerala	200	700	352	654	263	1656
Madhya Pradesh	44	377	128	264	20	458
Maharashtra	83	376	291	905	44	603
Orissa	22	59	280	450	34	211
Punjab	292	473	778	311	164	2277
Rajasthan	59	307	84	160	41	451
Tamil Nadu	139	670	72	195	62	1166
Uttar Pradesh	131	396	335	854	65	892
West Bengal	60	177	165	284	23	534

Note: Private investment as reported in the nation wide survey by RBI for the year 1981-82 and by the NSSO for the year 1991-92.

6 AGRICULTURAL INVESTMENTS, GROWTH AND EQUITY

The main aim of fixed investments in an economy is to provide impetus to growth process. Public investment achieve this goal by creating, improving and maintaining suitable infrastructure while private investment contributes by adding to stock of capital, durable assets, resource improvement etc, which augment productive capacity and also improves production efficiency. In a federal country like India balanced development of all regions and states is an important policy goal. This requires that resources for growth and development should be allocated in such a manner that it helps to achieve balanced growth of different states. In this Chapter, we first examine the relationship between agricultural growth, agricultural productivity and investments across states and then the changes in regional divergence in capital expenditure on agriculture sector on public account and on private account. Level of incremental capital output ratio (ICOR) for agriculture sector during the last 20 years has also been estimated based on CSO series and the broad series.

6.1 Agricultural Investments and Output Growth

Average annual public capital expenditure and private investment in agriculture at 1980-81 prices during the period 1974/75 to 1996/97 alongwith growth rate in agricultural output (NSDP agriculture) during the same period and agricultural productivity during the recent years and in early 1980s are presented in Table 6.1. The idea is to see the association between fixed investments made in agriculture during the past two decades and the indicators of agricultural development. During this period, annual public investment in agriculture in Jammu and Kashmir was Rs. 1242 per hectare, which was far higher than the next highest value. Thus J&K was not included in the equations estimated to establish relationship between agricultural development and fixed farm investments.

It would also be seen from the table that West Bengal recorded the highest growth rate in agricultural output and its agricultural productivity is also highest among all the states. But, with respect to public and private investment, West Bengal is among the bottom states. High agricultural productivity and growth in West Bengal seems to have resulted due to factors other than public and private fixed capital formation such as institutional reforms like Operation Barga.

Table 6.1 Statewise per hectare public and private investments, agricultural productivity and output growth rate at 1980-81 prices

Rupees

State	Private fixed Capital formation in agriculture		Annual Public Investment 1980-81 to 1995-96	Growth rate in NSDP agri 1981 - 82 to 1996-97 %	NSDP Agri. Per hectare	
	1981-82	1991-92			Triennium ending 1982-83	Triennium ending 1996-97
Andhra Pradesh	86	96	152	2.49	3303	4915
Assam	40	26	179	0.92	4543	5250
Bihar	43	38	181	-0.08	3678	4290
Gujarat	87	78	163	1.15	2713	3405
Haryana	195	176	190	4.42	4546	8242
Himachal Pradesh	104	229	285	2.72	4722	4477
J&K	100	63	1142	2.15	5634	7567
Karnataka	81	184	122	3.34	2475	3774
Kerala	210	257	270	4.28	5936	9703
Madhya Pradesh	51	138	97	3.58	1705	2713
Maharashtra	78	138	301	4.79	2090	3742
Orissa	23	21	175	-0.55	2591	2544
Punjab	262	173	516	4.30	5592	10093
Rajasthan	56	112	68	4.36	1454	2670
Tamil Nadu	133	245	82	3.95	3330	5716
Uttar Pradesh	132	145	281	2.77	4182	6110
West Bengal	52	65	99	5.67	4476	10664
Goa, Daman & Diu		163	1458	2.39	3947	4909
Arunachal Pradesh		222	1251	6.11	3467	6038
Manipur		173	1213	2.03	6511	8905
Meghalaya		35	522	0.99	3558	4084
Mizoram		87	1600	10.67	2032	5449
Nagaland		174	654	3.08	2064	1697
Sikkim		6	532	5.86	3401	4334
Tripura		14	1130	2.86	4806	6306
All India	89	126	213	2.92	3036	4611

The nature of relationship between indicators of agricultural development and public investment, private investment and other relevant variables was studied through multiple regression analysis. NSDP agriculture per hectare during TE 1996-97 and growth in NSDP agriculture during 1981-82 to 1996-97 were used as dependent variables. The explanatory variables were measured as under:

1. Public investment in agriculture: Taken as annual average of public sector capital expenditure on agriculture per hectare of net sown area during 1980-81 to 1995-96 at 1980-81 prices.
2. Private investment in agriculture: Taken as per hectare fixed capital formation in farm business. While estimating the equation for agricultural productivity, per hectare PFCF during 1991-92 was used as an indicator of private investment. In the output growth equation, average of PFCF during 1981-82 and 1991-92 was used.
3. Base year productivity: This was measured as triennium average of NSDP agriculture per hectare of net sown area during 1980-81 to 1982-83. This variable was expected to capture inter state variations in resource endowments and productivity potential already realised by various states in the base period. It was hypothesised to have positive relationship with current level of productivity and negative relationship with the growth rate.
4. Dummy for West Bengal was used to represent other missing factors which have helped that State to attain high level of agricultural productivity and growth.

The correlation coefficients among agricultural productivity, agricultural growth and other relevant variables are presented in Table 6.2.

Two sets of regression equations were estimated to study the impact of public and private investments on agricultural productivity and growth. One set includes all major states excluding Jammu and Kashmir and the second set excludes West Bengal and Jammu & Kashmir. The results for the first set, including West Bengal, are presented in Table 6.3.

When all the four explanatory variables are considered simultaneously, then, private investment, base year productivity and dummy variable for West Bengal turned out to have significant and positive influence on agricultural productivity across states. The impact of public sector capital expenditure was positive but it was not significant, the reason for which seems to be its significant correlation with, base year productivity. When base year productivity was dropped then the impact of public investment on agricultural productivity turned out to be significant at 10% level.

Table 6.2: Correlation coefficients among private and public investments in agriculture, and agricultural growth and productivity across major states. 1980-81 to 1996-97

	Productivity TE 1996/97 NSDP Ag/ha	Productivity TE 1982/83 NSDP Ag/ha	Capital expenditure/ ha 1980/81 to 1995/96	Per ha. private investment: Average of 1981/82 and 1991/92	Dummy for West Bengal =1 Other =0
Growth rate in NSDP Agri.	0.528	0.140	0.096	0.592	0.391
Productivity TE 1996/97 NSDP Ag/ha		0.883	0.457	0.568	0.501
Productivity TE 1982/83NSDP Ag/ha			0.562	0.496	0.197
Capital expenditure/ ha 1980/81 to 1995/96				0.471	0.224
Per ha. private Investment: Average of 1981/82 and 1991/92					-0.229

Note : Absolute value of correlation coefficient above 0.6055 is significant at 1 percent and the value above 0.482 is significant at 5 percent level of significance.

Private investment in agriculture shows stronger impact than public investments on inter state variation in agricultural productivity. Level of productivity already attained in early 1980s also has significant impact on productivity level across states during mid 1990s. The coefficient of dummy for West Bengal indicates that other factors specific to this state, like institutional reforms including operation barga, have played significant role in attaining high level of agricultural productivity.

Among the factors affecting growth of agricultural output, private investment showed positive effect, which was highly significant (Table 6.3). The states which had attained high level of productivity during early 1980s, recorded lower growth in the subsequent 15 years. The impact of dummy variable for West Bengal was significant and positive. However, the impact of public investment on the growth of agricultural output was not significant. When sum of public and private investments was used as one variable it showed significant positive impact on inter state variations in growth rates of NSDP agriculture.

Table 6.3:
Effect of public and private investments in agriculture on output growth and productivity

Dependent variable	Independent variables 1						
	Constant	Private investment	Public investment	Total Investment	Base year productivity	Dummy for W.B.	Adj. R^2
Output per hectare							
1	-619.135 (-0.866)	14.539 (3.010)*	1.554 (0.516)	-	1.055 (3.862)*	5558.805 (4.728)*	0.874*
II	885.391 (1.004)	22.419 (3.484)*	7.709 (2.053)***	-	.	7703.893 (5.059)*	0.728*
III	2433.389 (1.731)	17.697 (1.634)	5.114 (0.809)	-	-	-	0.215*"
IV	1114.803 (1.201)	-	-	12.484 (4.823)*	-	7582.966 (4.675)*	0.691*
V	-480.005 (0.590)	-	-	5.491 (2.008)***	1.098 (3.532)*	5363.843 (4.007)*	0.836*
Growth rate in output							
1	1.936 (2.827)**	0.0275 (5.945)*	0.0018 (0.632)	-	-0.00079 3.05)**	5.517 (4.90)*	0.739*
II	0.798 (1.06)	0.0215 (3.948)*	-0.0028 (0.891)	-	-	3.893 (3.015)**	0.558*
III	1.580 (1.77)***	0.019 (2.785)**	-0.0041 (1.033)	-	-	-	0.283"
IV	2.211 (2.02)***	-	-	0.0096 (2.614)**	-0.0071 (1.703)	5.131 (2.85)**	0.329"
V	1.178 (1.21)	-	-	0.0051 (1.87)***	-	3.693 (2.171)**	0.23*"

Notes:

1. Figures in parentheses are calculated T values.
2. *, **, *** indicate the coefficient is significant at 1, 5 and 10 % level respectively.

The second set of regression equations was estimated by excluding West Bengal from the observations on states. The results were almost similar to the first set in which West Bengal was included in the set of observations (Table 6.4).

These results show that the level of agricultural productivity and output growth rate are significantly affected by the level of fixed investment in different states. Thus, agricultural investments are an important instrument to raise level of agricultural productivity and agricultural

income. Here, the issue related to this is whether regional inequities in public and private investments have reduced over time.

6.2 Regional Divergence in Agricultural Investments

Inequalities in inter-state investments in agriculture were examined by comparing the coefficient of variation over time presented in Table 6.5. The coefficient of variation in public capital expenditure per hectare of net sown area among major states was 68 per cent during the 5th Plan period. Then it declined slightly to 65 percent during 6th plan. There was a sharp decline in inter state variation in capital outlay during 7th plan period and two years following this. However, during the Eighth plan period the variation witnessed steep jump to reach level of 70 percent.

Table 6.4 :
Effect of public and private investments in agriculture on output growth and productivity in Indian States excluding West Bengal

Dependent Variable	Constant	Private investment	Public investment	Total invest-ment	Base year product-ivity	Adj. R^2
Output per hectare						
1	-619.135 (-0.866)	14.539 (3.010)**	1.554 (0.516)	.	1.055 (3.862)*	0.84*
II	885.391 (1.004)	22.419 (3.484)*	7.709 (2.053)***	-	-	0.66*
III	-480.005 (0.590)	.	.	5.491 (2.008)***	1.098 (3.532)*	0.79*
Growth rate in output						
1	1.936 (2.827)**	0.0275 (5.945)*	0.00182 (0.632)	-	-0.0079 (3.052)**	0.71**
II	0.798 (1.067)	0.0215 (3.948)*	-0.00284 (0.891)	-	•	0.51*
III	2.221 (2.022)*"	.	-	0.0096 (2.614)**	-0.00071 (1.703)	0.26***

Notes :

1. Figures in parentheses are calculated 't values
2. *, **, *** indicate the coefficient is significant at 1, 5 and 10 % level respectively.

State specific information on private investment was available only for two years during the last two decades. During 1981-82, coefficient of variation in private investment was 65 percent which was close to the level of CV in public investment. In 1991-92, inter state variation in private invesments reduced to 55 percent as measured by C.V. (Table 6.5)

Table 6.5: Coefficient of Variation in per hectare public and private investments during different periods

	1974-75 to 1978-79	1980-81 to 1984-85	1985-86 to 1989-90	1990-91 To 1991-92	1992-93 To 1996-97
Public investment	68	65	48	47	70
Private investment		65*		55**	

Note: For major states excluding J&K.
* Refer to year 1981-82 and **refer to year 1991-92.

6.3 Incremental Capital - Output Ratio in Indian Agriculture

Analysis of incremental capital output ratio is useful to decide sectoral allocation of capital resources, to estimate level of investment required to attain specified output level and growth and to know efficiency of capital or investment. The ICOR for agricultural sector was worked out for the last 20 years based on CSO series on public investment and the broad series constructed by us. One year lag was assumed between investment and output. The estimates of incremental capital, incremental output and ICOR on 5 yearly basis beginning 5th Five Year Plan are presented in Table 6.6.

Table 6.6: Estimates of Incremental capital output ratio in Indian agriculture during 1974/75 to 1996/97

Aspect	1974-75 To 1978- 79	1980-81 to 1984-85	1985-86 To 1989-90	1990-91 To 1994-95
Incremental output* Rupees crore/year	1110	1612	2098	2038
Incremental private capital Rupees crore/year	2859	2894	3153	4328
Incremental public capital				
Broad series	4383	3637	2758	2684
CSO series	1328	1858	1509	1268
Incremental total capital				
Broad series	7242	6531	5911	7012
CSO series	4187	4753	4662	5596
ICOR				
Broad series	6.52	4.05	2.82	3.44
CSO series	3.77	2.95	2.22	2.75
ICOR assumed in Five Year Plans**				2.30
Growth rate of NSDP agri. Per cent per year	2.81	3.52	3.90	3.17

Based on 1981/81 prices.
* Incremental output computed by taking one year lag in capital and by using triennium averages of GDP agriculture. For instance incremental output during 1990-91 to 1994-95 refers to the difference in output between triennium 1994/95 to 1996/97 and triennium 1990/91 to 1992/93.
** ICOR for 9^{tth} Five Year Plan has been further reduced to 2.2.

There is a huge difference in the ICOR based on CSO investment series and the broad series during 1974-75 to 1978-79. The difference slowly narrowed down over time. According to CSO series one rupee increase in output per year require one time capital investment worth Rs. 3.77 during late 1970s. The capital requirement based on broad series was Rs. 6.52. The ICOR based on broad series declined sharply during 6th and 7th plan but increased during the first five year period of 1990s. This implies that marginal efficiency of capital in agriculture improved till 1989-90 and deteriorated in the subsequent quinquennium. The same trend is witnessed in the ICOR based on CSO series.

Compared to the estimates of ICOR obtained by this study, the Planning Commission has been using quite lower estimates. The Eighth Five Year Plan put ICOR for agriculture sector at 2.3 which has been further reduced to the level of 2.2 for the Ninth Five Year Plan (Ninth Five Year Plan 1997-2002, Draft Vol. 1 p.74). Accordingly, sectoral needs for investment in agriculture considered by Planning Commission to attain projected output level have been substantially under-estimated.

7 MAIN FINDINGS, CONCLUSIONS AND POLICY IMPLICATIONS

Time series information on public and private sector investments in different sectors of the Indian economy is provided by Control Statistical Organisation of Government of India. According to the CSO series both public and private investments in agriculture have been moving on a rising trend till 1980-81, based on which it was inferred that there is complementarity between public and private investments. However, after 1980-81, public sector capital formation started declining, in real term, whereas private investment kept moving upward. The disparate movement in two series since 1981-82 put a question mark on the widely accepted conclusion that private sector investment in agriculture is determined by the level of public investment. This has further generated lot of interest in understanding real relationship between public and private investments and in knowing implications of falling public investment in agriculture.

In the urge to find answer to such questions the researchers observed that CSO series on public investment does not include investments in several important heads like rural roads, rural electrification, markets etc., and that more than 90 percent of the public investment reported by CSO consisted of medium and major irrigation projects. Therefore, strong need was felt to have a comprehensive series on public investment in agriculture that includes all important items relevant for agriculture. It was also noted that statewise data on public investment in agriculture were not available, in the absence of which it was not possible to study implications of ongoing trend in public and private investment on regional growth and equity.

The present study has identified about 23 heads relevant for agriculture sector and has prepared country level and state level series on public investment for the period 1974-75 to 1996-97. The series have been constructed by using capital expenditure on the concerned items as reported in the publication Finance Account of the union and state governments. The broad series reveals that during 1974-75 to 1996-97 the capital expenditure on agriculture at current prices increased in all the states except Bihar and Punjab. In Bihar, annual capital expenditure on agricultural heads by the state followed decline after 7th Plan while the decline in Punjab set in after 6th Plan. Like these two states, capital expenditure on agriculture sector by union government also did not show rising trend at current prices.

At 1980-81 prices capital expenditure on agriculture for the country as a whole showed decline throughout, beginning with the 5th Five Year Plan (1974-75 to 1978-79). The decline was very sharp during 6th and 7th Five Year Plans when annual capital expenditure on public account declined Rs. 3637 and Rs. 2758 crore respectively from about 44 hundred era during 5th Plan. Likewise, the capital expenditure by union government declined by 45-50 percent in each successive Five Year Plan following 5 Plan.

Among major states, per hectare public investments in agriculture remained highest in Jammu and Kashmir - it was about 4-5 times the national average in all the four Five Year Plans. Due to its special status, the state is receiving special assistance for various agricultural development projects as is the case with small size north east states. Among the remaining major state Punjab allocated highest resources for infrastructure development for agriculture in all the plan periods. The second place from top was occupied by Himachal Pradesh during 5th Plan, by Uttar Pradesh during 6th Plan, and Maharashtra during 7th Plan and by Kerala during the 8th Plan period.

State investment for capital formation in agriculture was quite low in Rajasthan and Madhya Pradesh. Other states which invested low amount in agriculture are Tamil Nadu, Assam, and West Bengal.

Among small size north east states and Goa, Daman and Diu, per hectare annual capital expenditure on agriculture during last 23 years varied between Rs. 500 to Rs. 1606 which is substantially higher than the average of the country. Thus, with respect to public investment north-east states, a Jammu and Kashmir have been the more favorable compared to major states.

All major states and some of the small states show declining trends in the resources spent for infrastructure for agriculture. Among major states the rate of decline has been highest in Punjab followed by Bihar. At country & the series declined annually by 3.16 percent over the chosen period.

At all India level 9.22 percent of net domestic product (NDP) from agriculture sector was invested for capital formation in agriculture during the first five years of decade of 1980s. However, during the second half of 198 resources spent for agricultural infrastructure development declined to 7. percent of NDP from agriculture. The decline continued during 1990s a current share of resources for capital formation is around $1/20^{th}$ of t sectoral output.

Union government's contribution to capital formation in agriculture. constituted about 1.80 percent of NDP from agriculture during late 1970s. The contribution has dwindled to 0.25 percent during the 1990s.

Among major states, capital expenditure on agriculture in J&K corresponds to about 1/4th to 1/5th of NSDP agriculture in different plan periods which the highest. Among the remaining major states Maharashtra spent highest proportion of NSDP agriculture on agricultural infrastructure. The state invested about 13-18 percent of NSDP agriculture on capital formation in agriculture during 1974-75 to 1991-92. The allocation declined to below 10 per cent during the 8th Five Year Plan. Though Punjab invested highest in agriculture capital on per hectare basis after J&K among major states, it did not occupy same position in respect of percent of NSDP agriculture spent on infrastructure in most of the period.

During 5th Plan, agricultural investments on public account exceeded 8 per cent of NSDP in states of Uttar Pradesh and Gujarat beside the three states mentioned above. Assam, Bihar, Haryana, Kearala, Rajasthan, Tamil Nadu and West Bengal invested less than 5 percent of agricultural NSDP in the public capital during 5th plan. West Bengal remained at the bottom throughout in respect of agricultural investment. In Bihar, share of public investment in agricultural NSDP dropped from around 6 percent during 1980s to less than 2 percent during the 8th Plan. Though Haryana is agriculturally progressive state, its allocation of NSDP agriculture for farm investment remained lower than the national average in percent term.

The decline in share of capital outlay on agriculture in NSDP agriculture at current prices is less conspicuous and less widespread compared to per hectare and the total investment at constant prices. One reason for this is that price index of capital item (construction sector) has risen at a faster rate compared to general prices.

Among north-east states (other than Assam), public investment in agriculture constituted highest share (more than 30 percent) of NSDP agriculture in Arunachal Pradesh.

For the country as a whole, 4 percent of total national income was spent for infrastructure development for agriculture sector during 5th Plan period. This share kept falling over time and during 8th Plan period less than one and a half percent of national income was ploughed back for capital formation in agriculture.

Investment in major and medium irrigation projects continued as the dominant item of capital expenditure on agriculture. Investments in storage and warehousing were the second most important item of capital expenditure with 25 - 29 per cent share. These two heads account for about $2/3^{rd}$ of the total capital expenditure on agriculture by states and union government in the country. Crop husbandry was the third important item of capital expenditure during 1974-75 to 1978-79 with about 15 percent share in total capital expenditure on agriculture. Its

importance diminished subsequently. Investment in district and other rural roads With an investment of around Rs. 200 crore turned out to be the third most important item during 7th and 8th Plan period. Capital expenditure in rural electrification remained below Rs. 10 crore till 1989-90 and increased to Rs. 44 crore per year during 1990s. Importance accorded to create infrastructure for dairy development declined sharply after 5th Plan period. Public capital invested in fertiliser industry was around Rs. 266 crore per year during 5th Plan, Rs. 130 crore during 6th Plan and Rs. 71 crore during 7th Plan. Annual investment in fertilizer industry declined to around Rs. 20 crore during the 1990s.

Combined capital expenditure on hill and north - east areas and on other special area programmes has been steadily increasing despite the decline in overall capital expenditure on agriculture.

A comparison of CSO series and the broad series constructed by us shows that the public investment according to CSO constitutes 48 percent of the total public investment channelled to agriculture sector. Conversely, CSO series underestimated the public investment in agriculture to the tune of 52 percent. It was also examined how much of total investment under each series has been allocated to irrigation development consisting of major, medium and minor irrigation works, command area development and flood control. In most of the years investment under the irrigation head, as measured by capital expenditure, comprise around 90 percent of the public investment in agriculture as per CSO and average for the last 23 years was about 95 per cent.

Regarding the trend in public investment, the decline in it based on broad series started a little earlier then the decline in the CSO series. Thus, it is not correct to say that public investment for agriculture which includes all major heads like rural roads, rural electrification, storage, warehousing etc. has not declined even-though CSO series has declined. Further, the rate of decline in capital outlay on irrigation and allied heads was lower compared to the rates of decline in capital expenditure on other agricultural heads and in CSO series.

Time series information on private fixed capital formation in agriculture at country level is furnished by CSO but neither CSO nor state level statistics departments provide this information at state level on yearly basis, except for one or two states. This information at state level can be derived from the nation wide surveys for the year 1981-82 conducted by Reserve Bank of India, and for the year 1991-92 by the NSSO. According to the nation wide surveys about 87 percent of fixed capital formation in agriculture (FCFA) came from cultivator households though there is variation in it across sates.

During 1981-82, Punjab ranked at number one in per hectare private investments, but it showed sharp decline in the following decade at constant prices. Kerala, Tamil Nadu, Himachal Pradesh and Haryana were among top states with respect to per hectare private fixed capital formation in agriculture during 1991-92. Private investment per hectare of net sown area was awfully low in Orissa, Bihar, West Bengal and Assam. Rajasthan and Madhya Pradesh recorded very high growth in private investment in agriculture during the decade following 1981-82.

In sharp contrast to public investment, capital invested by private sector in agriculture in the smaller states was meager. Per hectare public investments in all the smaller states in north east region was higher than that in any other major state barring Jammu and Kashmir, whereas, private capital formation in agriculture in north - east states was lower than that in all major state.

Based on the positive association between public and private investments that continued till 1980-81, it was concluded by some researchers that public investment is the main determinant of private investment in agriculture. However, the divergent trend in the two series since 1981-82 forced the researchers to have a fresh look at the relationship between public and private investment and to explore what could be the determinant of private investments in agriculture.

We have studied the impact of public investment on private investment using CSO series and broad series on public investment at national level and by using statewise data for the years 1981-82 and 1991-92 at real prices. As the private investment in agriculture may be simultaneously affected by several variables, the effect of these variables was studied using multiple regression analysis.

Country level data show that the terms of trade for agriculture and institutional term credit advanced to farmers have positive and significant impact on private capital formation in agriculture. Public investment, both as per CSO and as per the broad series which include all important heads of capital expenditure, did not show positive impact on private investment.

The state level results show that during 1981-82, both public sector investments in agriculture as well as institutional term loans to farmers exerted positive and significant impact on private sector capital formation in agriculture. However, during 1991-92 public sector capital expenditure ceased to cause significant influence on private sector capital formation.

There is ample evidence that impact of public investment on private investment is not uniform in the pre 1981-82 and post 1981-82 period. In the pre 1981-82 period public investment was increasing which also caused favourable impact on private investment. However, the decline in public investment in agriculture, observed since 1980-81, did not cause the private investment to decline, contrary to what would be expected if there was complementarity between the two types of investments.

The relationship between public and private investment was further investigated using Cointegration analysis. Almost all the past studies have used raw time series to establish relationship between public and private investments. This can give spurious relationship if assumption of stationarity of the series is not satisfied. In this study we have proceeded by applying Augmented Dicky Fuller Test (ADF) to test the time series on public and private investment for their stationarity. The results show that raw series was not stationary. The series at first difference turned out to be stationary. After having established that the public as well as private investments each are integrated of order 1, the long run relationship between the two series was established through the estimation of cointegration between the two series. The results show that there is no long term relationship between the two series. From this it was concluded that positive or negative association observed by various researchers between the raw series of public and private investments in different periods is spurious as there is no true long term relationship between the two series.

The relationship of agricultural growth and agricultural productivity with public sector capital expenditure and private sector fixed capital formation has been studied using data for the major states. Both, the public as well as private investment in agriculture show positive and significant impact on agricultural productivity.

Though agricultural productivity is strongly affected by it, the impact of public investment on the growth of agricultural output was not significant. On the other hand, impact of private investment on output growth turns out to be highly significant. The impact of total investment on public and private account turned out to be positive and significant on both, agricultural growth as well as productivity.

Among various states, West Bengal recorded highest output growth and productivity though agricultural investment in this state was lowest. The coefficient of Dummy variable for West Bengal was positive and highly significant indicating that other factors, such as Operation Barga, have contributed significantly to agricultural growth and productivity in West Bengal. This also shows that beside public and private investments there are other powerful instruments for agricultural development.

Given that agricultural productivity and output growth are significantly affected by the level of fixed farm investment in different states, one way to reduce large inter- state inequalities in agricultural development in the country is through balanced allocation of capital expenditure

for agriculture. The coefficient of variation in public capital expenditure per hectare of net sown area among major states was 68 per cent during the 5th Plan period. Then it declined slightly to 65 percent during 6th Plan. There was a sharp decline in inter state variation in capital expenditure during 7th Plan period and two years following this. However, during the Eighth plan period the variation witnessed steep jump to reach level of 70 percent.

There was a huge difference in the ICOR based on CSO investment series and the broad series during 1975-75 to 1978-79. The difference slowly narrowed down over time. According to both the series marginal efficiency of capital in agriculture improved till 1989-90 and deteriorated in the subsequent quinquennium. Compared to the estimates of ICOR obtained by this study the Planning Commission has been using quite lower estimates. Accordingly, sectoral needs for investment in agriculture by Planning Commission to attain projected output level were highly on lower side.

The lack of complementarity between private and public investments stands out prominently. Terms of trade for agriculture and flow of institutional credit have turned out to be the strong determinants of private investments in agriculture. As private investment is found to be more effective than public investment in promoting output growth, it would be prudent to encourage private investments through institutional credit support and favourable terms of trade for agriculture. In particular, flow of institutional credit should be increased in low investment states like eastern states.

There could be several reasons for public investments to show non significant or even negative impact on private investments after early 1980s. Impact of public investment on private investment would vary depending upon type of public investment in different regional settings. All kind of public investment may not lead to or induce private investment. Some of the private investment in Indian agriculture may be induced by public investment and some may be autonomous. At micro-level there are some areas of investments where private investment can even be substitute for public investment. Misplaced priorities and leakages in public investments are the other reasons for lack of inducement effect on private investments.

Importance and role of public investment to create infrastructure and to promote long term agricultural growth should not be undermined by lack of complementarity between public and private investment. However, public investment would be effective in playing this role only if it serves the purpose for which it is created. There are instances when huge investment made in infrastructure in some areas soon ceased to serve its purpose due to lack of maintenance. '

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