CAPITAL FORMATION IN INDIAN AGRICULTURE
WITH
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TO
ASSAM AND WEST BENGAL

Dissertation
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MASTER OF PHILOSOPHY

RAJIB SUTRADHAR ·

Centre for Studies of Regional Development
School of Social Science
Jawaharlal Nehru University
New Delhi- 110067
INDIA
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DECLARATION

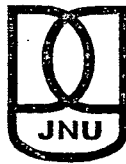I do hereby declare that the dissertation titled **"CAPITAL FORMATION IN INDIAN AGRICULTURE WITH SPECIAL REFERENCE TO ASSAM AND WEST BENGAL"** submitted by me is a bonafide work and it has not been submitted to any other university for the award of any other degree.

(Rajib Sutradhar)

It is hereby recommended that the dissertation may be placed before the examiners for evaluation.

Prof. Saraswati Raju
Chairperson

Chairperson
Centre for the Study of Reg. Dev.
School of Social Sciences,
Jawaharlal Nehru University
New Delhi - 110 067

Prof. Ravi S.Srivastava
Supervisor

Centre for the Study of Reg. Dev
School of Social Sciences,
Jawaharlal Nehru University
New Delhi - 110 067

Dedicated

To

My Parents

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Acknowledgements

ABBREVIATIONS

ADF   :   Augmented Dicky Fuller Test

AIDIS   :   All India Debt and Investment Survey

ASI   :   Agricultural Statistics of India

C.S.O.   :   Central Statistical Organization

DCU   :   Departmental commercial undertakings

GCFA   :   Gross Capital Formation in Agriculture

G.D.P.   :   Gross Domestic Product

GDPA   :   Gross Domestic Product in Agriculture

GDPN   :   Gross Domestic Product in Non agriculture

HYV   :   High Yielding Varieties

ICOR   :   Incremental Capital Output Ratio

ISIC   :   International Standard Industrial Classification

INSA   :   Indian System of National Accounting

LC   :   Livestock Censuses

NAS   :   National Account Statistics

NSS   :   National Sample Survey

NDCU   :   Non Departmental Commercial Undertakings

OLS   :   Ordinary Least Square

PC   :   Population Censuses

U.N.   :   United Nations

U.S.   :   United States

UN SNA :   UN system of national accounts

Introduction

Capital formation in any society is a result of increased production and some part of it being directed to the making of capital goods instead of using the same for immediate consumption. As Nurkse points out, the term is used to include investment in skills, education and health − a very important form of investment[1]. The U.N. paper on Concepts and Definitions of Capital Formation[2] observed that fixed capital formation of enterprise is "the expenditure for machinery, equipment, buildings and other construction works . Measured in this fashion capital formation is related to increase in the production capacity of enterprises". Agricultural production in its simplest form also required some amount of capital, though theoretically it may be possible to get production from the combination of land and labour only[3]. According to Tostlebe who made a pioneering study of capital formation in U.S. agriculture, capital formation must be viewed "not as an automatic process but a response to investment of money, effort and time in new resources or facilities of production."[4] In other words, capital formation can be defined as an addition to the stock of productive equipments over time. The concept of capital formation in agriculture in the normal terminology comprises of investment in agriculture, land development, soil conservation, rural roads, agricultural machinery, storage and other items, the return from which is expected over a period. When considered broadly, investment made on research, education and technical training for the development of human capital should also be included since this increases the efficiency of the operator leading to increase of output on the farm[5]. Going by this definition, it won't be extravagant to say that the efficiency of agricultural production is directly

[1] Ragner Nurkse : Problems of Capital Formation in Underdeveloped Countries, Basil Blackwell, Oxford, 1957,p.2

[2] United Nations: Concepts and Definitions of Capital Formation, 1953, p7.

[3] Tara Shukla: Capital Formation in Indian Agriculture, Vora & Co, Publishers Private Ltd, 1965, p.1

[4] A.S.Tostlebe: Capital in Agriculture: Its Formation and Financing since 1870, National Bureau of Economic Research, Princeton University Press,1957,p.6

[5] P.C.Bansil: Role of Irrigation and Fertilizers in Capital Formation, *Indian Journal of Agricultural Economics*. Vol.24.No.4,1969,p.18

related to the increasing use of inputs like improved seeds, fertilizers, pesticides etc and consider that the amount spent on these items is a part of capital formation.

Capital formation, particularly on government account, has radically transformed Indian agriculture in the course of last half a century of planned development. From chronic hunger and abject dependence on the import of foodgrains, the country has achieved not just self-sufficiency in the production of foodgrains; it has also turned into a net exporter of foodgrains in the last few years.[6] Though service sector has emerged as key player thanks to India's prowess in the IT sector, agriculture continues to be a key player, both in terms of share of its contribution to GDP and employment generation. Agriculture still retains its top position in employment generation, absorbing over 60 percent of labor force in the country, even though its share in the country's GDP has declined to below 25 percent. Public investment has played a critical role in this dramatic transformation of Indian agriculture in the last half a century. However, agricultural sector has witnessed some disconcerting developments in terms of decline in real capital formation on government account in last two and half decades. This trend has evoked debates on two lines- whether there has been really any decline in public investment in agriculture over the last two decades and secondly, if it is so, has it been made good by the increase in the private investment. Debates on the first line are triggered by the changing composition of public investment as CSO data is not exhaustive. In this context, Dantwala's perceptive distinction of government expenditure "in" and "for" agriculture is worth noting. The government expenditure or investment "for" agriculture would include such expenditures as on rural roads, rural electrification, public sector fertilizer plants, rural education and health and so on, which are legitimate as these are also public and quasi-public goods[7]. As CSO does not include 'investment for agriculture' in its estimate of capital formation in agriculture, some economists contest the notion of declining government capital formation as reported by the CSO. They believe that decline in

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[6] C.H.Hanumantha Rao: State of Indian farmers, vol 1, 2003,p.i

[7] Bhupat M Desai and N.V. Namboodri: Government Expenditure on Agriculture under Planning era in: *Agricultural Development Paradigm for the Ninth Plan under New Economic Environment,* Bhupat M Desai(ed), Oxford & IBH Publishing Co p.982.

government capital formation in agricultural sector has been made up by increase in investment in rural roads and electricity that has considerable forward and backward linkages to agriculture. They maintain that that both kinds of investment taken together may not portray a picture as gloomy as the one if one considers only 'investment in agriculture'. The second line of argument is based on the nature of relationship between the Public investment and Private investment in agriculture. They held that even if the government capital formation in agriculture in broad sense declines, there is no reason to be concerned about as it is no longer a driving force in private capital formation in agriculture. Private investment in agriculture continues to rise during the last two decades, a period that observed steep fall in government capital formation in the same sector. Issues like capital formation in agriculture and its measurement continue to be strongly debated in the background of changing scenario in the country's agricultural sector.

However, most of these arguments are largely based on aggregate analysis (all India) level and hence do not reflect the regional picture. This is more so when there exists substantial variation across states in terms of agricultural development as well as capital formation[8]. There are substantial differences in capital formation, public as well private across states. The issues that crop up in the debate of public and private capital formation are – is private capital formation adequate and good enough to obviate the need of public capital formation altogether? Can private investment, without the active participation of the state machinery, achieve the avowed objectives of reducing inter and intra- regional inequalities in the state?

In the light of the above discussions, we have taken up the following objectives for the purpose of our study:-

(i) To estimate the trends in capital formation in agriculture, public and private at the national level for the period of 40 years, starting with 1961 till 2001.

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[8] M.S.Jairath and Brijesh C.Purohit: "Trends in Capital Formation in Agriculture- A Case of Arid India" *Indian Journal of Agricultural Economics,* vol.51, No.4, Oct-Dec.1996, p587.

(ii) To estimate the trends in capital formation in agriculture, public and private at the state level for the period of 20 years, starting with 1981 till 2001.

(iii)To examine the relative importance of the different heads of the budget expenditure in the states' agriculture.

(iv)To explore the political economy of the observed trend of public and private capital expenditure in agriculture in the last four decades and suggest the policy option specifically for the strengthening the process of capital formation in agriculture.

In our research proposal, we endeavour to settle some issues of the debate by exploring them first at the national level and then at the state level. At the state level, the study is restricted to just Assam and West Bengal. Our decision to limit the coverage at the state level to just two states are driven by two factors- *firstly*, there is not much sense in making comparison between states if they are already very different to begin with. Given the initial level of agricultural development, one can not deduce much conclusion out of comparison between two states; say Punjab and Assam or Himachal Pradesh. *Secondly*, Assam and West Bengal are located in the same climatic zone. Though West Bengal and Assam were at similar level of development two decades back, the spectacular performance of the former in the past two decades even at a time when agriculturally developed states like Punjab and Haryana are struggling to sustain their performance makes for an interesting case study.

We have tried to approach the issues of capital formation in agriculture in two steps *Firstly*, the measurement of capital formation in agriculture- how the public and private capital formations in agriculture are estimated, i.e., what sources are used in their estimation and what components of expenditures are considered.

Secondly, after estimation, we have tried to explore the relationship between the public and private investment- i.e., whether the relationship is one of substitution or complementary both at national level and state level.

We have arranged our works in four chapters. The first chapter mainly deals with the literature survey and methodological issues of capital formation. The literature is not unanimous on the relationship between the public and private investment in agriculture, with one group of economists still supporting the complementary relation between the two types of investment while others suggest that such relation has weakened over time. The methodological issues involve two aspects- one is estimation of capital formation and the other is technical one- what statistical techniques are used in examination of the relation between the two. Given the paucity of data and lack of accounting habits among illiterate farmers, the estimation of capital formation in agriculture is always a tricky business. An enquiry into capital formation faces several difficulties ranging from concepts and definitions of capital formation to problems of measurement and availability of requisite data with the adequate number of observations[9]. The second chapter begins with the examination of the trend in the public and private investment in agriculture at the national level for a period of four decades from 1960-61 to 2003-04 and their relationship over the same period. In the same chapter, we have also tried to explore the factors, apart from public investment, that induce private investment in agriculture. In the third chapter, we have tried to replicate the same at the state level albeit with a shorter period from 1981 to 2001. The decision to limit the state level study to a shorter period is driven by the frequent changes in geographical area of the states, particularly Assam before 1980s. The fourth chapter tracks the changes in the structure of capital expenditure of Assam and West Bengal on both the private and public account in the last two decades. In that chapter, we have tried to make a comparative analysis of the asset structures of the two states and the role such differences played in the performances of the states' agriculture. We have followed this with a conclusion where we have an upshot of the entire analysis of capital formation in agriculture and policy implication of our research work.

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[9] Tara Shukla, op. cit. no.1, p.vi.

Literature and Methodology

Decline in capital formation in Indian agriculture on public account over the last two decades has been a source of concern among economists and policy makers. Initially, serious concern was expressed about the decline in public capital formation in agriculture since early 1980s and its implication on private capital formation and consequently for growth in the sector. However, the economists are not unanimous over these issues. Subsequently, the debate turned to several other issues like determinants of public and private investment and other definitional and measurement aspects of public sector capital formation in agriculture. Following is the brief attempt to give an outline of the literature on capital formation in agriculture.

2.1 Literature Review

A number of studies in recent years have expressed grave concern about the decline in capital formation in agriculture in the last two decades. They (Rath1989, Rao Hanumantha 1994, Alagh1994, Krishnamurthy and Shetty1990, Mallick, 2001,Dhawan and Yadav1995,1997 and Dhawan1996) believe that decline in public investment in agriculture is not only bad in itself, it is also bad because it has simultaneously led to decline in private capital formation and therefore total capital formation in agriculture since 1980s'. Their argument is based on the assumption that the relation between public and private capital formation in agriculture is complementary.

However, there is another strand of views (Mishra and Chand, 1995, 2001, Chand, 2001, Chand and Kumar, 2004, Misra and Hazell, 1996a, 1996b, 1997, Mitra, 1997) that have questioned the validity of this complementarity hypothesis. They maintain that even though there is some complementarity between two types of capital formation, this relation has gradually weakened since 1980s. Chand and Kumar (2001) summed up this debate over the relation between the public and private investment in agriculture as "If the study period was dominated by the phase when both the series, public and private capital formation, were moving on rising trend, then the relationship turned out to be positive. For the post

1980-81 periods, which was marked by a declining trend in public sector capital formation, but a rising trend in the private sector, the relationship between the two series was found to be hazy. Some scholars found the relation to be negative; some found it to be zero and some, who strongly believed in a positive relationship, proved the same by using some variant or proxy for public sector capital formation like area under canal irrigation and net fixed capital stocks." [1]

Rath (1989) first raised the issue of declining public capital formation in agriculture and its implication on private capital formation. He took a serious note of decline in production in agricultural sector during eighties and attributed it to the decline in real investment in the sector in the sixth and Seventh Five Year Plan. Though Rath acknowledged the importance of private investment in agriculture, increasingly financed from bank loans, he was not convinced that without greater public sector investment and other appropriate policy measures, the vast regions characterized by poor agricultural growth can come up and use institutional credit to a greater extent. [2]

On the relationship between the public and private investment in agriculture, Rath observed "the wider spread of irrigation water and irrigated crops to hitherto unirrigated areas will lead to greater possibility of tapping and recycling speeded water that provides better basis and possibility of private investment in wells and pumps."[3] He summarized the relation between the public and private investment as one that may not have one to one correspondence, but one that is 'closely tied, the successful execution of the latter being dependent on the full and proper implementation of the former.'[4]. Shetty (1990) endorsed Rath on his observation on the complementary relation between the public and private capital formation in agriculture. After reviewing the trends of public and private sector investment in agriculture, essentially based on the new series of NAS published by the CSO, Shetty looked at the trend of institutional credit since 1969 and unfailingly noted that

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[1] Ramesh Chand and Pramod Kumar: Determinants of Capital Formation and Agriculture Growth"
   Economic and Political Weekly, Vol39,No52,Dec25,2004 ,p5611
[2] Nilkantha Rath: Agricultural Growth and Investment in India, *Journal of Indian School of Political Economy,* Vol.1, No.1, 1989 p.72.
[3] ibid,p.72

the behavior of private sector investment in the 1980s does not square with the more rapid growth of institutional credit for medium and long term purposes. He lent support to the complementary hypothesis as he observed, "Reduced public sector investment in agriculture combined with an unattractive growth horizon, adverse terms of trade, poor per capita income growth and inadequate growth in savings, may have adversely affected both the incentive and ability for farm households to invest in agriculture."[5]

Like Shetty, A Ganesh Kumar also used New Series of National Account Statistics (NAS) at 1980-81 prices and observed that agricultural investment has shown a clear fall, both in level and also as percentage of the total investment. Kumar used the 'Agriculture, Growth and Redistribution of Incomes Model (AGRIM)[6], a computable general equilibrium model of Narayana, Parikh and Srinivasan to assess the consequences of a fall in agricultural investment. In the model, Kumar showed that even the favourable terms of trade failed to trigger investment in the agricultural sector. The model indicated that one of the fallout of declining public investment in agricultural sector is greater rural inequality.

Close on the heels of the studies by Rath (1989), Shetty (1990), and Kumar (1992) follows the work by Sushanta Kumar Mullick, who aims at re-examining the trends of public and private capital formation in agriculture with new data by considering the longer time series from 1950 to 1990 available on a comparable basis. In his regression exercise that models private investment in agriculture as a function of public investment in the sector with one year lag, Mullick found the relation between the public and private capital formation in agriculture to be complementary one -

$$PVGCFAGR_t = 1216.5 \quad + \quad 0.96333 \; PUGCFAGR_{t-1} \qquad \text{Adj. } R^2 = 0.80$$

$$(4.3883) \qquad (4.0766) \; \text{------------------ ------ } (2.1) \quad D.W = 2.09$$

[4] ibid,p.72
[5] S L Shetty: Investment in Agriculture – Brief Review of Recent Trends, *Economic and Political Weekly*, Vol25,Nos7,8 February17-24, 1990, p397.
[6] NSS Narayana, KS Parikh and TN Srinivasan: *Agriculture, Growth and Redistribution of Incomes Model*, North Holland / Allied Publishers

Mullick observed, "To a large extent, public and private investments are complementary, rather than substitutes for each other, and thus falling public investment may be affecting private capital formation."[7]

The secular decline in the public investment in Indian agriculture since early 1980s and refusal of its complementary relation with the private investment during the same period by some quarters has recently triggered some debates about the pertinent issues of capital formation in Indian agriculture. Among the economists who led the counter attack of the complementary relation between the public and private capital formation in Indian agriculture, B D Dhawan is most prominent. He devoted considerable amount of time in the research of the related issues of capital formation in agriculture, that culminates in four papers on the topic, viz, Private Fixed Capital Formation in Agriculture (1995), Relationship between Public and Private Investments in Indian Agriculture with Special Reference to Public Canals (1996), Trends and Determinants of Capital Investments in Agriculture (1996) and Public Investment in Indian Agriculture (1997).

Dhawan and Yadav (1997) contested the notion that decrease in public capital formation in agriculture since 1980-81 might have been offset by increase in public capital formation in some other sectors which have close bearing on the production performance in the agricultural sector. In the absence of data of capital formation in electricity, the study relied on the absolute number of villages electrified in a year as surrogate measure of investment in rural electrification. Evidence on this front has also suggested that such public investment too has shrunk since 1980-81[8]. Dhawan and Yadav (1995) gave a good account of the investment behaviour of the farmers at the state level based on AIDIS, 1981-82 as they tried to explore private capital formation in agriculture as function of credit to agriculture and public investment in irrigation. They showed that the extent of irrigation development, connoted by gross irrigated area as percent of net area sown of a state, had positive bearing on the Fixed Capital Formation in the agricultural sector (r = 0.79).In the

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[7] Shusanta Kumar Mullick: Capital formation in Indian Agriculture: Recent Trends, *Indian Journal of Agricultural Economics*, Vol. 48, No.4, Oct-Dec, 1993.p.675

[8] B.D.Dhawan and S.S.Yadav (1997): Public Investment in Indian Agriculture- Trends and Determinants, *Economic and Political Weekly*, Vol.32, No.14, April5, 1997, p.713.

multivariate regression analysis, the authors have found two variables namely, Gross Irrigated Area as percent of net sown area (GIA) and CANAL as net canal irrigated area as percent of net sown area in the year 1980-81 as significant factors influencing fixed capital formation in agriculture

$$\text{FCFA} = -114.75 + 0.32 \text{ CREDIT} + 7.21 \text{ PREF} + 1.676 \text{ GIA} \text{ ------------------- (2.2)}$$
$$\quad\quad (-4.24) \quad\quad (6.10) \quad\quad\quad (5.18) \quad\quad\quad (3.12) \quad\quad R^2 = 0.9513, n = 17$$

Where CREDIT stands for borrowings from institutional sources, PREF stands for per cent share of FCFA in total capital expenditure per cultivator (per cent), n stands for the no of states.

$$\text{FCFA} = -- 123.03 + 0.35 \text{ CREDIT} + 7.60 \text{ PREF} + 4.62 \text{ CANAL} \text{ --------------- (2.3)}$$
$$\quad\quad (--4.26) \quad\quad (7.10) \quad\quad\quad\quad (--5.30) \quad\quad (2.92) \quad\quad R^2 = 0.9603, n = 17$$

The authors noted that higher positive values of the coefficients of both the variables in the function of fixed capital formation in agriculture underscored the complementarity in the relation between the public and private investment in agriculture.

Dhawan (1996a) extended his argument to the micro level as he took the pains to analyze the effect of public canals on private investment based on two field surveys of Punjab and Karnataka. The author used public canals as proxy for public capital formation in agriculture as it accounts for the bulk of the total public fixed capital formation in Indian agriculture. His case study shows that canal irrigation ratio bears a significantly positive correlation with total private fixed farm investment (r=0.65) as well as with investment in agriculture machinery (r=0.74).[9]

The survey of average investment expenditure in the farms conducted by the paper in the state of Punjab reveal that it was higher in regions with canal irrigation like South-Western Punjab (Rs 808) than regions where private tube well irrigation was the main source of irrigation like Central Punjab (Rs 486), and the semi hilly northern Punjab (Rs 624) where both canals and tube wells were in use. The evidence showed that public

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[9] B.D.Dhawan : Relationship between Public and Private Investments in Indian Agriculture with Special Reference to Public Canals, *Indian Journal of Agricultural Economics,* Vol.51, Nos 1 and 2, Jan-June1996,p.215

investment in canal irrigation encouraged farmers to expand his sown investment in the farm.

The authors' case study of Malaprabha and Ghatprabha Projects Unit of the state of Karnataka in the same paper is complementary to his similar study of Punjab, as it deals with the impact of public canals using both with and without and before and after approaches of project evaluation. His case study of two projects in Karnataka shows that areas, recipient of canal water or areas, imminent beneficiaries of canal water had higher per farm investment expenditure than the areas outside such project. The study both at micro and macro level has vindicated the authors' conviction that public investment in canal irrigation in India stimulates private investment in agriculture, including investment in private means of irrigation. Dhawan (1996b) complemented the earlier research on capital formation in agriculture as it tried to explore the determinants of private fixed capital formation in agriculture.

As a case study to explore the dynamics of private investment in agriculture, the author has cited the mechanism of how irrigation works by government can stimulate investment in agriculture on private account. He pointed to the concentration of institutional lending for agricultural development in irrigated land as an outcome of the farmers' ability to self finance farm investment as well as improvement of his ability to repay the loans once the transition from dry land agriculture to irrigated one takes place.

Apart from public irrigation, Dhawans' multiple regression analysis has shown public investment in rural electrification to be an important variable along with institutional credit in the function of private investment in agriculture. In his regression exercise, Dhawan also examined how public irrigation impinge on the farmer's investment in non-irrigation related investment: land reclamation, field bunding and other land improvement, farm implements and agricultural machinery; farm houses, barns and animal sheds, transport carts and trolleys; orchards and plantations. In his exercise, Dhawan found the availability of institutional credit (r=0.93) as single most dominant factor followed by canal irrigation (r = 0.66) and rural electrification (r = 0.64) in explaining interstate disparity in non-

irrigation investment during 1981-82[10]. Dhawan later observed, "extent of irrigation development in a state, whether under public or private aegis, plays a substantial role in fixed capital formation in irrigation related investment."[11] Shenggen Fan, Peter Hazell and S K Thorat (2000) gave strong support to Dhawan (1996b) as they, as a part of multiple equations model, examined the influence of public irrigation and rural electrification in private irrigation and found the former encouraging private irrigation in a significant way (co-efficient= 0.918), lending support to the complementary hypothesis between public and private irrigation.[12] Realising its importance in poverty alleviation and productivity growth, the authors urged the government to revert the recent trend of decline in government expenditure in irrigation. Gandhi (1996) also found that government capital formation continued to have positive significance for private investment, particularly for the period of 1952-53 to 1980-81.In his non-linear estimation procedure that explored private capital formation in agriculture, Gandhi found that rural savings and co-operative credit to agriculture emerged as the strongest determinants of capital formation in agriculture, followed by HYVs, agricultural wages and commercial bank.[13]

Recent debates on the capital formation in Indian agriculture, particularly the complementary relation between the public and private capital formation in the sector stems from the refusal of the same from a number of researchers of late. It includes several literatures by Mishra and Ramesh Chand(1995), Misra V N and Peter Hazell (1996), Misra V N and Peter Hazell (1996), Misra V N and Peter Hazell.(1997), Mitra Ashok(1997) , Chand Ramesh(2001).

Mishra and Chand (1995) lead the brigade of economists who question the hypothesis of complementary relation between the public and private investment in Indian agriculture as they attempt to provide an explanation of the behavior of public and private capital

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[10] B.D.Dhawan: Trends and Determinants of Capital Investments in agriculture. *Indian Journal of Agricultural Economics*, Vol.51, No.4.p.554.
[11] ibid,p.540
[12] Shenggen Fan, Peter Hazell and S K Thorat: Impact of Public Expenditure on Poverty in Rural India, *Economic and Political Weekly,* Vol.35,No.41,September30,2000,p.3585
[13] Vasant.P.Gandhi: Investment Behaviour in Indian Agriculture. *Indian Journal of Agricultural Economics,*vol.51,No4.p.540

formation in agriculture during the post green-revolution period in terms of its political economy. The authors observed that the relation between the public and private investment in agriculture is not complementary, may be partly of inducement. In this regard, Misra and Chand observed, "On a more charitable note, one can argue that the inducement effect hypothesis is at least for the period of 1980s, spurious and private sector capital formation is indeed autonomous."[14] They also calculated the incremental capital output ratio (ICOR) and marginal efficiency of the capital to show that there has been continuous improvement in the efficiency of capital use in Indian agriculture since the Seventh plan. The authors undermined the issue of declining public capital formation in agriculture by claiming that there is nothing disastrous about the fall in the share of a sector in total investment in the light of changing composition of GDP. During this period, the service sector has displaced primary sector as the major contributor of GDP, pushing agriculture into the third position after secondary sector. They viewed that the sector's own rate of investment, which is a better indicator and of more importance, is not so bad in recent past.[15]

Though the debate on the hypothesis of complementary relation between the public and private capital formation in agriculture was first raised in Chand and Misra (1995), Chand (2001) is more comprehensive analysis on the debate. In Chand (2001), the author constructed a new and broad series on public investment in agriculture at the all India level and the state level by taking into account all important heads of public investment in agriculture. Chand showed that the new series fall more sharply than the earlier series of public investment since mid 1980s and vindicated Dhawan and Yadav (1997) that fall in the public expenditure in agriculture was all pervasive. In Chand (2001), the author questioned the methodologies used by Dhawan (1996) and Dhawan and Yadav (1995, 1997) to establish the complementarity between Public and Private capital formation in agriculture. Instead of using the entire irrigated area as measure of public investment, Chand suggested that 'addition made to that area' or the potential created during the last

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[14] SN Misra and Ramesh Chand: Public and Private Capital Formation in Indian Agriculture- Comments on Complementary Hypothesis and others. *Economic and Political Weekly*, Vol.30, No.25, June24, 1995, p.A70.
[15] Ibid.p.74.

few years be used for examining the relation between the two[16]. Chand used the co-integration test to check the nonstationarity of data and later used the Engle-Granger two step procedures to establish that there is no long run relationship between the two series. In the multivariate regression analysis, Chand showed that public capital expenditure in agriculture ceased to exert positive influence on private capital formation in agriculture in the period, 1981-82 till 1996-97.

The more serious argument that is being made now by scholars like V.N.Misra and Peter Hazell (1996a) relying on the work of Misra and Chand is that public investment in agriculture does not have a crowding in effect on private investment.[17] They examined the complementary relation between the public and private investment in a behavioural framework in three different phases of development covering the four decades of Indian agriculture (i.e. 1952-53 to 1990-91). In their log linear model, the coefficients of public investment are found to be changing from 1.551(in the period 1960/61 to 1969-70), 0.688 (in the period 1970/71to 1979-80) to – 0.313 in thé period 1980-81 to 1989-90. In the multivariate régression exercise, the authors found the terms of trade and technology to be more important variables than public investment in stimulating private investment in agriculture. They observed, "The positive effect for terms of trade in explaining the output variations during the last four decades of Indian agriculture at low level of significance is quite important, particularly when viewed in the light of the earlier negative coefficient."[18] Misra and Hazell (1996b) and Misra and Hazell (1997) have countered the critical observations by B D Dhawan on their earlier paper. Alagh played down the findings of Misra and Hazell as it considered gross capital formation instead of gross fixed capital formation[19]. Misra and Hazell (1997) later considered both gross capital formation and gross fixed capital formation in agriculture and got the same conclusion.

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[16] Ramesh Chand : Emerging Trends and Issues in Public and Private Investment in Indian Agriculture: A State wise Analysis, *Indian Journal of Agricultural Economics,*2001,Vol.56, No.2 p.175

[17] Yoginder K. Alagh: Agricultural Investment and Growth, *Indian Journal of Agricultural Economics,* vol.52,No.2,April-June1997 p.282

[18] VN Misra and Peter B Hazell: "Terms of Trade, Rural Poverty, Technology and Investment" in *Economic &Political Weekly.*Vol.31, No.12, March30, 1996, p.A2.

[19] Yoginder K. Alagh, op.cit.no1,p.282

In Misra and Hazell (1996b), the authors cleared the allegation that they undermined the influence of non-price factors in Private Capital Formation. Their response was "despite both the coefficients (i.e. the terms of trade and public investment) being significant at 15 percent level, we have referred to terms of trade as the most important and public investment as quite weak, mainly because the former has been viewed in the light of the earlier negative coefficient, whereas the latter has been seen in the light of strong relationship observed during the 1960s and 1970s."[20] It also emphasized that the inter-correlation among public investments, terms of trade and technology were also not high enough to influence the coefficient of each other in the multi-variate analysis in the previous paper. Misra and Hazell (1997) has made some methodological corrections to the earlier model and extended the data coverage to include several post-reform years (up to 1993-94) to update their analysis. However, even after the reformulation of the model, the new results show that the coefficient of the public investment is insignificant and provides little direct evidence of a complementary relation between public and private investment in Indian agriculture.[21]

Mitra (1997) also expressed reservation on the hypothesis of complementary relation between public and private capital formation in agriculture. Though it largely concurs with the opinions expressed by Mishra and Ramesh Chand (1995) Chand Ramesh (2001), Chand and Kumar (2004), Misra and Hazell (1996a, 1996b, 1997), it is not as vocal as the above literature. At constant prices, the positive and significant correlation between the public and private investment at 1year,3years and 5 years lag during the period from 1960-61 to 1979-80 gives rise to negative and significant correlation between the public and private sector GCF in agriculture with different lags in the period from 1979-80 to 1990-91.[22] Similarly, the regression coefficients of public capital formation as determinants of private capital formation at constant prices for the same period with different lags are

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[20] VN Misra and Peter BR Hazell: Price and Non-price Factors in Agricultural Investment, *Economic and Political Weekly,* Vol32. Oct26, 1996p.2892

[21] VN Misra and Peter BR Hazell: Price and Non-price Factors in Agricultural Investment (Discussion), *Economic and Political Weekly,* vol.32, No.30,August2-8, p.1997

found to be negative and significant.[23] In the end, it maintains that a priori hypothesis of complementary relation between the public and private investments in agriculture is not supported by both the correlation and regression analysis of the data on public sector and private sector GCF in agriculture. Recognizing the limitations of statistical exercise, the author, however, refused to conclude that the relationship could be one of substitution or of independence between the two.[24] Gulati and Bathla (2001) have also expressed circumspection about strong complementary relation between the public and private capital formation in agriculture. Though Gulati and Bathla, in their regression exercise, found a positive relation between the public and private capital formation in agriculture, it refused to vouch for the complementary relation between the two because of the limited empirical evidences in the last two decades to support such hypothesis in Indian economy. After acknowledging the role of public GCFA and its decline since mid 1980s, they, however, concluded that the scenario in the farm sector is not as bad as it is made out to be. In their view, part of the explanation lies at the diversification within agriculture from food grain output to non-food grain output and consequent decline in public investment in irrigation projects.[25]

The overall survey of literature on capital formation in Indian agriculture gave the impression that jury is still out on their judgments on the impact of public capital formation on private capital formation in agriculture. Though no one objects to the complementary relation between the public and private capital formation in Indian agriculture in pre1980s, the same cannot be said about the post 1980s. While some economists like Dhawan, Mullick, Yadav, Shetty and Kumar still persist with their strong views on the complementary relation between them, there is another brigade of economists that include Chand and Misra, Kumar, Misra and Hazell who suggest that the relation is no longer complementary one. They maintained that the positive association between the public and

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[22] Ashok Mitra: Public and Private Investments in Agriculture, in ' *Agricultural Development Paradigm for the Ninth Plan under New Economic Environment,* ' Bhupat M Desai(ed), Oxford & IBH, Publishing Co.1997,p.972

[23] ibid,p.974

[24] ibid,p.975

private capital formation in Indian agriculture became weak in the post 1980s. There is another group of economists that include Mitra, Gulati and Bathla who are cautious in their opinions about the relation between the types of capital formation in agriculture in the last two decades.

2.2 A Note on Measurement of Capital Formation in Indian Agriculture:

A part of the recent debate on capital formation in Indian agriculture is how one estimates capital formation in agriculture. This issue figures quite frequently in such discussion, especially in the background of some observations that decline in the public capital formation in Indian agriculture in last two decades can be attributed to missing items that are usually reckoned for the estimation of capital formation. Many authors feel that the composition of public expenditure in the rural India has undergone significant changes over the years, as the 'expenditure for agriculture' has increased and substituted 'expenditure in agriculture'.Though there is plenty of literature on the capital formation in Indian agriculture, not all of them deal with issues pertinent to the estimation of capital formation on both public and private account.

Measurement and estimation of capital formation is always a tricky problem. As the U.N. paper points out, capital formation could be measured at any of the several stages in the process, e.g., the accumulation of funds, expenditure of funds, or the production of capital goods.[26] Most of the literature on capital formation in agriculture have so far considered two approaches, namely, inventory approach and the expenditure approach. Both methods have own merits and demerits. The inventory approach, apart from usual problem of reliability of data, quite often face the handicap arising from the non-availability of data on certain items or from lack of comparable data over a period of time in some others. Moreover, problems of valuation and weightages to be assigned to different items are always there.

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[25] Ashok Gulati and Seema Bathla : Capital Formation in Indian Agriculture –Revisiting the Debate, *Economic and Political Weekly*,Vol.36,No.19May19,2001,p.1706

[26] R Rammana & T.P.S. Chawdhari : Some Reflections on the use and Formation of Capital on Farms in *'Indian Journal of Agricultural Economics*, Vol.24,No.1,1969,p.117

On the other hand, the expenditure approach at the farm level may give more reliable results. This method has its own demerits. Unless surveys are conducted over a period of years, it may not be possible to find out long term trends. Moreover, there are certain problems of measurement in this approach as well. Firstly, the surveys conducted so far have taken account of money expenditure only. It is necessary that the value of materials used for which no monetary payment is made or value of family labour and labour on exchange basis may also be included. Secondly, for purpose of netting, it is necessary to note separately the expenditure of repair and maintenance particularly in respect of items like bunding and other land improvement. Although it is possible to make some allowance for depreciation in respect of tractors, electric pumps, it may not be possible to do so in respect of small tools and equipments. Similarly, allocating the expenditure on purchase of cattle under annual purchases and sale replacement purchase etc is not an easy task. Apart from these two methods of accounting, Jakhade[27] made a mention of the Production Approach, which is based on statistics of production and imports of capital goods. However, in Jakhades' view, the adoption of this method in Indian agriculture is more likely to lead to its underestimation as the volume of building and repairs of farm and residential buildings, cattle sheds, land reclamation and improvements, carried out by the farmers with the help of family labour is large and remains outside the monetary sphere. Though the 'monetary expenditure' approach has its own share of problem, it is, in authors' view, more feasible and practical as compared to the other methods for collection of statistics relating to the capital formation in agriculture. TS Raos' work, in this regard, is worth noting. He made mention of two methods for the estimation of capital formation[28].

Firstly, making an estimate of annual income, then of the savings out of that income which are devoted to investment or addition to capital assets, apart from those devoted to the repair and maintenance of existing assets.

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[27]V.M Jakhade: "Capital Formation in Indian Agriculture- A Note on Methods" *Indian Journal of Agricultural Economics,*Vol.4,No.1&2,1954,p.99

[28] TS Rao : "Some Aspects of the Problem of Estimating Private Capital Formation in the Agricultural Sector in India " in *Indian Journal of Agricultural Economics,* Vol.4,No.1&2,1954,p.104

Secondly, making an estimate of the value of capital assets at the beginning and end of the year, the difference between the estimates, after providing for depreciation and obsolesce, being the estimate of net capital formation during the year.

As both these methods are beset with several shortcomings, the author suggested ascertaining actual expenditure incurred on various assets as the only viable method of obtaining data about capital formation in agriculture with some reservations. He suggested that expenditures that represent mere transfer of assets within the community like purchase of land or loan made to others be omitted in the calculation of capital formation. In his view, another limitation of such method is difficulty in drawing a clear line of distinction between expenditure of a "current" type and that of a "capital investment" type. As often the case, the difficulty with the estimation of capital formation in livestock and "implements, machinery and other transport equipment" is always there. Similarly, the construction and repair of houses which were put to many uses like farm houses often pose serious problems in the estimation of capital formation. Such multipurpose use of building and their limited marketability bring an element of subjectivity as to whether they should be included as part of capital formation. The gradual emergence of a group of farmers that make substantial "non-farm business investment" creates an element of confusion in regards to how such investment should be treated. Despite several limitations, Rao finally suggested the use of this method as the only alternative in the absence of other reliable methods for the calculation of capital formation in agriculture.

The discussion on the measurement of capital expenditure in agriculture so far drives home the point that estimation of capital expenditure in agriculture is always a complex exercise, more so in a rural economy like India, where most of the farmers are still illiterate or semi-literate and they have hardly any accounting habits. Given the lack of precise guidelines on how to calculate capital formation in agriculture, it is better to start with the CSO approach as yard stick. It puts all items of expenditure under three groups, viz, "residential plots or buildings", "farm business" and "non-farm business"

depending on where and how they were used. However, only farm business is our concern.

The CSO defines farm business as one that comprises household economic activities like cultivation, including cultivation of plantation and orchard crops and processing of produce on the farm, e.g., paddy hulling and gur making. In the CSO's definition, there is no criterion to include particular activity in farm business as the emphasis is more on the method of processing and production rather than the activity itself. If gur making, even though a manufacturing activity, is carried out in the farm by indigenous method, it is covered under farm business. Such activities, when carried out under the registered sector and also under the unregistered sector outside the farm, are not considered as part of farm business.[29] Farm business also included activities ancillary to agriculture, like livestock raising, poultry, fishing, dairy farm activities, bee keeping and other allied activities.

CSO captured capital expenditures in the farm sector under the following headings

Purchase of land:

CSO considers any cost borne towards purchase of land for farm business as capital expenditure in the farm sector.

Purchase of land rights:

It includes any expenditure made to improve tenurial status. Apart from that, any installment payment made to government towards purchase price of land settled on tenants in terms of land reform legislations comes under this heading of capital expenditure in farm.

Building and other land improvement:

This includes all expenses to facilitate irrigation, conserve moisture, prevent soil erosion, protect crops from floods etc.

Reclamation of land:

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[29] All India Debt and Investment Survey, Report No.437,NSS 48th Round,1992,p.8

Reclamation of land refers to all expenses made towards either by bringing new land under cultivation or land which had earlier been under cultivation but temporally gone out of cultivation.

Orchards and plantation:

The term 'orchards' means garden of fruit plants and trees while the term 'plantation' refers to other gardens like those of coconut, cashew nuts, tea, coffee, rubber, cardamom etc. The cost of annual replantation and new plantation and addition during the reference period were also considered here. For new orchards and plantations, expenses incurred up to the time they started yielding produce was considered. Expenditure on bund and other land improvement relating to the orchard and plantation were not considered here but shown under bunding.

Well and other irrigation resources:-

Any expenditure incurred towards construction of such structures or making major repairs or alterations of existing ones –including those made to augment their capacity are considered under this head.

Agricultural implements and machinery:

Any implements – which are used in farm business, are included here. They were included even when they were used partly in the farm business and partly in non-farm business and household business.

Transport Equipment:

All such equipments put to use in farm business were included. They were also included even when they were put to use partly in non-farm business or even in households in additions to being used in farm business.

Farm houses, barns and animal sheds:

Farm houses which were located separately from the residential buildings etc were only considered. Constructions of purely temporary nature or farm houses attached to residential buildings were excluded from such consideration.

Furniture and fixture:

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This included costs of such items used exclusively for the farm business or both for farm and non-farm business. However, if used also for household purpose, these costs are not considered as capital expenditure meant for agriculture.

Other capital expenditure:

This included any cost borne on any other item of farm business like preparing hedges for erecting fences around the field etc which were undertaken for permanent protection or improvement of the farm.

Apart from CSO, M.B Deshmukh and M.P Bhargava[30] gave a good account of the items to be included in the estimates of capital expenditure in agriculture. In their view, the capital expenditure in agriculture mainly comprises of expenditure incurred on areas like permanent improvements of land, a shift to intensive cultivation, improved implements, machinery, purchase of land, expenditure incurred to continue the cultivations as a going concern etc.

The authors have identified the investments in agriculture that are needed to continue the cultivation as 'working capital' or 'circulating capital' which includes expenditures on seeds, casual labor, transport, animal feeds etc. As part of measures to increase the capital formation in agriculture, they have called for increased government intervention to ensure remunerative prices and adequate flows of credits to agriculture.

Though CSO has considered any cost borne towards the purchase of land and land rights for farm business as part of capital expenditure in farm business, some economists have expressed reservations on such approach. Regarding the capital expenditure on land and land transfer, M.B Deshmukh and M.P Bhargava[31], have discussed at length the issues relating to the measurement of investment represented by land transfer in four categories.

a) From non-agriculturists to non-agriculturists.

b) From non-agriculturists to agriculturists

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[30] MB Deshmukh and M.P.Bhargava: 'Capital Formation in Indian Agriculture' *Indian Journal of Agricultural Economics'* Vol.4, No.1&2, 1954, p.120.
[31] Ibid.p.121.

c) From agriculturists to non-agriculturists

d) From agriculturists to agriculturists

As transfer of land from non-agriculturists to non-agriculturists has no bearing on the agriculture, the authors turned their attention to the other heads of land transfer. In the case of transfer of land from the agriculturists to non-agriculturists, the authors treat them as increased investment in agriculture if the payment received from the sale of agricultural land is invested for furthering the cultivation of residual holding. However; they considered the transfer of land from non-agriculturists to agriculturists as flight of capital from agriculture as they thought that such resources are most likely to be utilized for non-agricultural purposes. On the other hand, transfer of land from one agriculturist to another balance out each other and it represents no net transfer of capital from agriculture.

Ashok Mody made suggestions for some alterations to AIDIS to arrive at his own estimate of Gross Capital Formation or Gross Physical Investment in Agriculture. He asked for deduction of the expenditure on purchase of land and land rights from the estimates of Gross Capital Expenditure, reported by the Debt and Investment Surveys, on the assumption that the bulk of land transaction were between rural households[32].

However, it was Tara Shukla[33], who first made attempts to estimate capital formation in Indian agriculture for a period that dates back to pre-independence period. In the absence of any reliable data on working capital, Shukla has confined her study to the durable physical assets, particularly to items like land, buildings, irrigation, work animals and farm equipments. Her work on estimation of capital expenditure on land is very comprehensive.

Shukla obtained the data on land cultivated and irrigated from Agricultural Statistics of India (ASI) published annually. Similarly, the author used data regarding work animals, farm implements and machinery from quinquennial publications of Livestock Censuses

[32]Ashok Mody : Rural Resources Generation and Mobilization in 'Economic and Political Weekly'Vol.18,No.20,1983

[33]Tara Shukla, op. cit,no2,, p.vi

(LC). She also computed labor force in agriculture on the basis of decennial Population Censuses (PC), which also gave the information regarding rural houses.

Collection of data for the different heads of capital expenditure is not an end itself in the exercise of estimation of capital expenditure in agriculture. As concrete value data are required for aggregating and assigning weights to different heads in accordance with its importance, Chukla tried to assign values to each different component.

Land: As the valuation of land is beset with many difficulties due to interregional and intra-regional variations in soil conditions, the author took the median of values based on different studies by Dandekar in Maharastra and by Iyengar in Hyderabad and the Farm Management studies in Bengal, Madras, Punjab and Bombay Maharshtra as the representative of the value of land per acre in 1950-51 for the country.

Irrigation: Similarly, the author measured the difference between the values of irrigated and unirrigated land on the basis of the above studies to get an estimate of investment in irrigation. She obtained the total investment by multiplying the difference in value per acre by the total net area irrigated. She had done it irrespective of the source of irrigation, whether canal and dam, well or tank or whether it is publicly owned or privately owned.

However, she later recalculated the investment on irrigation on several grounds:-

Firstly, the index based on irrigated area alone may not reveal a true trend regarding the investment efforts made by the community as the appreciation of land value may be attributed to a number of causes other than increase in productivity owing to irrigation. *Secondly,* there is a time lag between the potential capacity created and actually utilized irrigation projects, particularly in case of major irrigation works with longer gestation period. Though actual capital outlay on such projects with appropriate adjustments for price changes during the intervening period is the norm followed in assessment of capital formation, following such procedure is handicapped by paucity of such data, especially in the respect of private sector. For public sector investment in irrigation, the author has prepared a chain-base index on the basis of data for outlay on stock of capital in irrigation obtained from the Statistical Abstract of India after adjusting them for the non-reporting States. As the prices are in terms of historical prices, the author adjusted them to the 1950-

51 price level by using the investment cost index prepared by Mukherjee and Sastry for the period 1938-39 to 1949-50. As for the private irrigation, the author has constructed the index of private irrigation on the basis of five year averages of the area irrigated by wells, private tanks and other sources.

Bullocks: Shukla used the prices of bullocks reported in "Agricultural Situation in India", "The marketing Report on Cattle" (MR) and NSS. She first worked out an unweighted average of market prices reported in Agricultural Situation in India for each region and took a median of these as representative of all India price to avoid the extremes. Similarly, she took the median of the prices available in the MR and finally the average of these two as all India price for bullocks for the year 1950-51.

Implements and machinery: She used the Poona schedule of NSS to get the prices of wooden plough and carts. Similarly, the information from the traders in Bombay and Bombay City Market were used to get the values of iron ploughs, tractors, sugar crasher and electric pumps.

Prof Shukla estimated separate public and private investment for both gross and net capital formation. The author added up investment in irrigation, land reclamation and tractors by the state to get an idea of total public investment in agriculture. She also assumed that tractors and land reclamation before 1950-51 were entirely the result of private efforts. However, she categorized investment in public canals in all states and majority of the areas irrigated by tanks in Bombay and Madras as part of public investment. The author also made allowance for depreciation in tractors though she didn't opt for such exercise in land reclamation and irrigation. Shukla also ignored indirect contributions from the state such as loans, subsidies and funds to the co-operative societies. She, however, accounted for co-operative loans contributed by the Government through the Reserve Bank as part of public investment in agriculture.

Among other authors who tried to measure private capital expenditure in agriculture are Mujumdar and Menon (1991), Dhawan and Yadav (1995) and Ashok Mitra (1997). Almost all of them have followed similar approach, based on All India Debt and

Investment Survey (AIDIS). N.A.Mujumdar and K.A.Menon[34] used the data drawn from the National Account Statistics, Report of the working Group on Savings, All India Debt and Investment Survey and the paper on "Trends in Rural Savings and Capital Formation" by Raj Krishna and Roychoudhury to compute capital formation in agriculture.

. The authors grouped real or physical capital used in agricultural operation into four types of physical assets, namely (1) farm land and buildings (2) implements and machinery (3) livestock and (4) changes in stock. Though land and buildings are fundamentally different, the authors reckoned expenditure incurred for reclamation or leveling of land for enhancing its productivity in the estimation of capital formation. Apart from these items, they included following items in the measurement of capital formation-

a) Construction of new bunds, major alterations and additions to the existing bunds and other land improvement works.

b) New plantations and additions to the existing orchards and plantations

c) Constructions of new wells

d) Construction of new irrigation resources and major alterations like road broadening and deepening of existing irrigation resources.

e) Purchase of new agricultural implements, machinery, transport equipment

f) Construction of new farm houses, grain galas, and cattle sheds.

In the calculation of gross capital formation, the authors excluded forestry, logging and fishing from the list of the items to be included as part of areas under agriculture.

Dhawan and Yadav (1996)[35] used AIDIS, 1981-82 for much of the information on capital expenditure and capital formation of farm sector. They have followed the same heads of capital expenditure as Mujumdar and Menon. Prof Mitras' work on private capital

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[34]N.A.Mujumdar and K.A.Menon: Saving and Capital Formation in Agricultural Sector: A Review, in *Indian Agricultural Development Since Independence,* M.L. Dantawala and others (eds.), Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi,pp.234-296.
[35]B.D. Dhawan and S S Yadav: Private Fixed Capital Formation in Agriculture-Some Aspects of Indian Farmers' Investment Behaviour , *Economic and Political* Weekly,Vol.30,No.30,Sept30,1995 pp.A103-A110

expenditure in agriculture is no different as he has followed the same procedure as Mujumdar and Menon, Dhawan and Yadav.

Of late, the work on estimation of capital formation in agriculture on private account by B.C.Roy and Suresh Pal[36] is worthy of note. As CSO provides time series information on Private investment only at the country level, the author has turned to AIDIS for the same at state level. The authors prepared a state wise time series data on private agricultural investment that contains investments made by both household sector and private corporate sector. Though the country level CSO estimates were used, the authors used the RBI-NSSO data for the share of individual state. The authors followed this procedure because of two reasons. *Firstly,* CSO does not deal with the state level data on the capital formation as its data coverage is only confined to the central level. *Secondly,* CSO and AIDIS data on private investment differ on the composition of investment. The coverage of CSO data is more exhaustive than AIDIS as the later does not cover private corporate investment in agriculture.

However, as far as the capital expenditure in agriculture in public account is concerned, Mitra's approach is different from what most of the other authors have used. He obtained the data on improvement of land and irrigation works and flood control projects, laying of new orchards and plantations and purchase of agricultural machinery and implements in the public sector by analyzing budget documents and annual reports[37]. He prepared the estimates of capital expenditure in respect of tea, coffee, and rubber plantations, which are mainly in the private corporate sector, on the basis of data of area on extensions and replacement available in the annual reports of Tea, Coffee and Rubber Board. Except for food grains, Mitra prepared the estimates of changes in stock on the basis of the inventories held by the industries.

Among other authors, Ramesh Chand has made some vital contribution. on the issues of the estimation of capital formation in agriculture on public account Chand is the first one

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[36] B.C.Roy and Suresh Pal: Investment, Agricultural Productivity and Rural Poverty in India: - A state level analysis, *Indian Journal of Agricultural Economics*,Vol.57,No.4,Oct-Dec,2002 p.655
[37] Ashok Mitra, op. cit, no1, p.946

to dispel the confusion on the limited coverage of public expenditure in agriculture by considering all the broad heads of budget expenditures relevant for agriculture[38]. B.C.Roy and Suresh Pal[39] has followed Chands' work on the estimation of public capital formation in agriculture and used almost the same heads of public capital expenditure as Chand.

Chand has constructed the series of public capital expenditure in farm sector, based on detailed information on different heads and sub heads of capital expenditure, reported in the Budget account and Finance/Appropriation Account of Union and the state government. The author has constructed the series at constant (1980-81)prices for the period 1974-75 to 1996-97 The series includes many heads of capital expenditure half of which are not included in the CSO series:--

1)Crop husbandry 2) Soil and Water Conservation 3) Animal husbandry 4) Fishery 5) Forestry and Wildlife 6) Food Storage/ warehousing 7) Dairy Development 8) Agricultural research and education 9) Agricultural Financial Institutions 10) Co-operation 11) Other Agricultural Programme 12) Other Rural Development programme 13) Major irrigation 14)) Minor irrigation 15) Hill Areas 16) North east areas 17) Other Special area Programmes 18) Command area development 19) Flood control projects 20) Rural electrification 21) Fertilizer industries 22) District and other roads.

Our current study has considered all the broad heads of capital expenditures that have any direct and indirect bearings on the performance of the agricultural sector. We have mainly consulted the Budget Accounts and Finance Accounts/Appropriation Accounts of both the central and state governments for the calculation of public capital expenditure in agriculture. Our scope of data coverage includes broad heads of budget expenditures like

    (i) Capital Account of Agriculture and Allied Activities,

    (ii) Capital Account of Rural Development

    (iii) Capital Account of Special Area Programme

    (iv) Capital Account of Irrigation and flood control projects

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[38] Ramesh Chand ,op cit.no1,p.169
[39] B.C.Roy and Suresh Pal. op.cit,no.1,p.654

Needless to say, each of the major heads contains many minor heads of capital expenditure. Apart from these major heads of capital expenditures; we have added three minor heads of capital expenditure, not covered under the aforesaid major heads- capital expenditures on road construction, fertilizer industries and rural electrification. In other words, our coverage of public capital expenditure in agriculture tallies with the coverage of the same by Chand (2001), Roy and Pal (2002).

We have used CSO data for the capital expenditure in agriculture on private account at the national level. Though AIDIS contains the information of private capital expenditure in agriculture at the national level, it does not account for the private corporate expenditure in agriculture. However, CSO has not taken any such initiative at the state level. We have, therefore, resorted to All India Debt and Investment Survey (AIDIS), 1981-82, 1991-92 and recently published 2002-03 issues for the information of private capital expenditure in agriculture at the state level. As AIDIS publish information about private capital expenditure in agriculture only at the interval of a decade, we have interpolated these values for the intermediate years.

2.3 A Note on Methodology:

Methodology used to examine the relation between the public and private capital formation in agriculture merits serious attention as the result from the same set of data varies depending on methodologies one uses. Barring few articles, most of the literature on capital formation has used correlation and regression analysis. Though Rath (1989) was the first to note the declining capital formation in agriculture, his work was mainly devoid of any statistical technique. Shetty (1990) calculated 3 yearly Moving Averages for both Gross Capital Formation and Gross fixed Capital Formation in the agricultural sector to eliminate the influences of extreme values in a particular year[40]. He later calculated annual compound growth rate in percent for Gross fixed capital formation in agriculture at 1980-81 prices. As only CSO data is considered, he, by that implication, excludes capital formation, by public and private sectors, in allied activities like forestry and logging and fishing and also capital formation in any other industry of use having any bearing on

agricultural sectors through backward and forward linkages. Shetty, however, justified it on the ground that these investments are at best complementary in the sense that 'it is not a situation where due to substantial investment in agriculture in the past, there exists "unutilized production potential" in the sector which could be exploited by directing more of investment into those non agricultural sectors which supply various inputs for agriculture'[41].

Mullick (1993) has used relatively simple technique. Apart from compound rate of growth of asset formation in agriculture, Mullick has estimated the trend growth rates for Gross Capital Formation in agriculture (GCFAGR), Public Gross Capital Formation (PUGCFAGR) and Private Gross Capital Formation (PVGCFAGR) by using the semi-log model:

$$y_t = \Box e^{\Box t} \text{ or } \log y_t = \log \Box + \Box t \text{ ----------------------- (1.1)}$$

In his regression exercise, Mullick models private investment in agriculture as a function of public investment in the sector with one year lag. In the model, the Durbin Watson test revealed first order positive auto-correlation, which the author later corrected by using Pagan's procedures[42].

For major part of their works, Dhawan and Yadav have used correlation and regression exercise. Dhawan and Yadav (1995) first calculated the correlation coefficient between the extent of irrigation development as connoted by gross irrigated area as percent of net area sown of a state and the fixed capital formation in the agricultural sector, which shows high degree of correlation (r = 0.79). In the multivariate regression analysis, they treated two variables namely, Gross Irrigated Area as percent of net sown area (GIA) in 1980-81 and CANAL, as net canal irrigated as percent of net sown area in 1980-81, as determinants of fixed capital formation in agriculture at the state level in two separate

[40] S L Shetty, op cit,No.1,p.390

[42] Shusanta Kumar Mullick,op.cit, No.1, p.675

regression equations, with Credit and the share of capital expenditure in agriculture to total capital expenditure in agriculture as two other determinants[43].

In Dhawan (1996a), which mainly focuses on case studies, the author calculated correlation coefficient of the average private investment in irrigation per cultivator household during 1981-82 and the canal irrigation ratio, which is though not high enough, but positive. Similarly, the correlation coefficients of canal irrigation ratio and total private fixed farm investment as well as investment in agriculture machinery are calculated.[44] Dhawan (1996b) runs linear multiple regression for both private investment in irrigation and non-irrigation investment per cultivator household separately on combinations of variables – Credit, Rain, PREFIRR, Canal, Rural electrification.[45] It is worth mentioning that PREFIRR indicates farmers' preference for irrigation vis-à-vis non-irrigation options. Dhawan and Yadav (1997) have explored Public Capital Formation in Agriculture as function of loan, saving, share of agriculture and average loan in regression analysis.

Mitra (1997) have mainly used the correlation and regression analysis with public and private investment in agriculture as only two variables both at current and constant prices. In both regression and correlation analysis, Mitra has used Public Investment in agriculture at lag 1 year, 3years and 5years as determinant of private investment in agriculture. Unlike Mitra (1997), Misra and Hazell (1996) has used log linear equation to show private investment in agriculture as function of public investment in agriculture for three phases 1960-61 to 1969-70, 1970-71to 1979-80 and 1980-81 to 1989-90. They later followed it by scrutinization of the behavior of private investment as functional relationship involving three independent variables, viz, Gross Terms of Trade (percent), Technology denoted by Percent of area under High Yielding Varieties and Public Investment at 1980-81 prices for the period 1960-61 to 1989-90. To corroborate the earlier findings, Misra and Hazell (1997) has shown Gross Capital Formation and Gross Fixed Capital Formation as function of mainly two variables -Public Investment Lagged One year

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[43]B.D.Dhawan and S.S.Yadav, op cit,no1,p..A106
[44]ibid,p.A106
[45] B.D.Dhawan, op cit, no.1,pp.529-541

and Interaction Term between Terms of Trade and Technology for two phases 1966-67 to 1980-81 and 1981-82 to 1993-94.[46]

Gulati and Bathla (2001) examined two set of factors – physical and financial that effect private investment in agriculture in his regression analysis[47]. In the first exercise, where the authors chose to examine the importance of physical factors, he regressed private investment in agriculture on canal intensity, power supplied, institutional finance, terms of trade index lag one year, public investment lag one year in log linear form. In the second exercise, he ran the regression of private investment in agriculture on the cumulative financial investment of the same variables.

A close look at the methodologies followed by the literature so far suggest that most of them have used regression analysis straightaway without any treatment to the data. However, if the data is non-stationary, such data are more likely to give spurious relation. In this respect, Chand (2001a) and Chand (2001b) are improvement over the earlier studies, as it took care of nonstationarity of data by applying Augmented Dicky Fuller Test (ADF) to examine the stationarity of time series on public and private investment. This test examines the null hypothesis of non-stationarity against the hypothesis of stationarity. He used Dicky Fuller Test and ADF to show that raw time series were not stationary, which was later corrected by taking first difference. He later used Engle-Granger two step procedures. In the Engle Granger two step procedures, the first step involves the estimation of the residual term by fitting OLS, which is later tested for stationarity by using the unit root test.

In his paper, Chand divided the entire period 1960-61 to 1996-97, into two sub periods 1960-61 to 1980-81 and 1981-82 to 1996-97 because of turn around in public investment after 1980-81.Though Chand (2001a) and Chand (2001b) admitted the limitation of regression analysis because of high degree of multicollinearity among public investment, terms of trade and institutional advances to agriculture, he tried to have some

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[46] VN Misra and Peter BR Hazell, op cit, No.1, p.1991.
[47] Ashok Gulati and Seema Bathla,op cit,No.1,p.1704

ideas about the nature of relationship between dependent and independent variables by running regressions including different combinations of independent variables .

Roy and Pal (2002) have used simultaneous equation model and 2Stage Least Square Method in his behavioral framework of public and private capital formation in agriculture. As a part of the simultaneous equation model, Roy and Pal (2002) introduced per hectare public agricultural investment (PUBINV) and per hectare private agricultural investment (PVTINV) as endogenous variables. The authors expressed the variables as

$$PUBINV_t = f (PROD_{t-1}, SUBSG_t, GOVREV_t, GRANTS_t, POPGR_t, LITR_t)$$

$$PVTINV_t = f(PUBINV_{t-1}, TOT_t, CREDIT_t, LITR_t, SUBINP_t, POVR_{t-1}, PROD_{t-1}, POPGR_t,$$
$$MARGINAL_t, ROAD_t, MKT_t, VE_t)$$

They defined the variables as

PROD = per hectare AgSDP

POVR= percent of population below poverty line

SUBSG= State Government agricultural subsidy

GRANTS= Grants for agriculture received from the Union Government

GOVREV= Government revenue (Rs/ha)

TOT= Terms of Trade: ratio between agricultural and non-agricultural GDP deflator (per cent),

POPGR = Population growth rate (per cent)

LITR = Rural literacy (per cent)

SUBINP= Total input subsidy

MARGINAL = Per cent area under marginal holdings (per cent),

VE = Villages electrified (per cent)

MKT = Rural market density (number of markets per thousand hectare)

ROAD= Road density (km per thousand hectare),

CREDIT= Institutional credit to agriculture sector (Rs/ha)

They estimated the model by pooling cross-section state-level and time-series data from 1970-71 to 1998-99. As the pooling of data poses some estimation problem, Roy and

Pal used Dummy Variable Model (DVM), taking Uttar Pradesh as control (base)[48]. They also used Hausman Specification test to test the simultaneity between different pairs of endogenous variables. As the test confirmed the simultaneity between different pairs of endogenous variables, Two Stage Least Squares (2SLS) estimation procedure is used to remove the simultaneity bias.

Our methodology in the study of capital formation in agriculture is mainly based on co-integration test. The use of non-stationary data can lead to spurious relation if one does not give any treatment to the data. We have applied Augmented Dickey Fuller Test (ADF) to test the time series on public and private investment for their stationarity. We have followed it by two step Engel-Granger procedure to estimate the residual term and test its stationarity. After that, we have used multiple regression analysis with private investment in agriculture as the dependent variable for two sub periods 1967-68 to 1984-85, 1985-86 to 2003-04. In our regression exercise, we have increased the lags of public investment in capital formation on the ground that public investment in agriculture takes longer periods for its effect to get magnified on the private investment. We have replicated the same exercise both at the national level and state level and later resorted to correlation analysis to examine the direction of the public and private capital formations in agriculture with different lags in different sub periods.

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[48] B.C.Roy and Suresh Pal. op.cit,no2,p.659

Chapter-2

Capital Formation in Agriculture-I

An all India level analysis

Public Sector has played a key role in the development of Indian agriculture in the 50 years of planned era. This initiative from the Public sector has been reflected in several initiatives taken by the government over the period. Apart from the measures like government price support for important crops, subsidization of key farm inputs like fertilizers, electricity, institutional credit support, the government has taken active participation to expand the productive base of the farm sector through direct public investment in irrigation schemes, soil and water conservation works, land reclamation, construction of regulated market structures for farm produce, research in farm technologies etc. All these efforts to enhance capital formation have been mainly driven by one single objective of achieving food security.

However, decline in public investment in Indian agriculture since mid 1980s has recently generated considerable debate and interest. The debate revolves around two issues- whether public investment in agriculture has actually declined since 1980s, and how its relation with private investment in agriculture has undergone changes over the same period in the light of no apparent decline in the later. The debate involves some methodological aspects as many researchers feel that narrow coverage of CSO data and recent surge in the public expenditure in the heads with strong positive influence on agriculture but hitherto not covered by the CSO tend to result in the underestimation of the role of government in capital formation in the sector.

As a background to the debate, it is worthwhile to see whether the concept and composition of public capital formation in agriculture as adopted by CSO in the Indian System of National Accounting (INSA) is comprehensive enough to encompass all the angles of capital formation and draw a comparison of the same

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with the international practices standardized by the UN system of national accounts (UN SNA). With the better understanding and improvement in the technique of data collection, the guidelines on SNA get revised from time to time, the last revision being made in 1993.

As per the UNSNA, the economy is divided into 11 industries, following the International Standard Industrial Classification (ISIC) of all economic activities. The establishments that are engaged in the similar type of activities are grouped in one unit. After grouping of productive activities, a separate account is made for gross capital formation and the estimates are set in as per (a) the type of capital goods acquired (machinery/equipment, construction and inventories), (b) industrial uses to which these capital goods are put, and (c) institutions (public, private and households) that have undertaken capital outlay[1]. The categorization of capital goods according to the industries of use is done using expenditure approach.

A close scrutiny into the ISNA account reveal that India also follows the guidelines set by the U.N. with slight modifications that suit its economy. Apart from the nine industries of use included in the ISNA as opposed to the 11 in UN SNA, the Indian SNA deviates from it on a few accounts as illustrated below[2]. In stark contrast to the U.N.SNA that includes only the operating costs of Irrigation system under 'agriculture and allied activities' industry of use and puts the construction work on the same in the 'construction industry' of use, Indian SNA put all expenditures of maintenance and capital in agriculture industry. This departure from the UN standard is rightly justified on the ground that very much like expenditure in land reclamation, soil conservation and drainage works, expenditure on irrigation, is mainly spent for agriculture development.[3] However, the Indian system of National Accounts does not

[1] Ashok Gulati and Seema Bathla,op cit,no2,p.1700
[2] ibid.p.1700
[3] ibid.p.1701

account for any investment in the power sector to agriculture, though substantial amount of power is used by agriculture for pumping irrigation water.[4]

Though there is nothing sacrosanct in adhering to the strict criteria in defining public capital investment in agriculture, there is certainly a need to redefine it to capture all the heads of capital expenditures, whose ramifications are strongly felt in the agriculture. This need is strongly felt in the Indian context, where CSO definition of public capital formation leaves out expenditures on some important heads like rural roads, rural electrification, rural markets and water shed development. Though there are some obvious limitations of data on private capital formation on account of the absence of information on the capital formation that takes place in the unorganized household sector and by the private co-operative societies, the same can not be said about the public capital formation. As there is no constraint of access to data / information in the public account, the need of the hour is to redefine and re-estimate the public sector investment in agriculture.

2.1 Structure of Public Investment in Agriculture

The structure of public investment in agriculture is decomposed into three sub-sectors: agriculture proper, forestry and fishery. It is the agriculture proper that predominates the capital formation in the public account as the other two parts namely forestry and fishery account for less than 10 percent with latter less than half percent of investments in agriculture as a whole. The public GCFA is estimated through investments undertaken by the departmental commercial undertakings (DCU), non-departmental commercial undertakings (NDCU) and the administrative departments. In the total public sector investment in agriculture and forestry, only investment by DCUs and NDCUs are considered[5]. This is because the administrative departments are designated only with the role of providing and organizing common services and not sale of these services on commercial basis as done by DCUs. Of the total expenditures incurred through DCUs and NDCUs, the expenditures incurred on

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[4] ibid.p.1701
[5] ibid.p1699

irrigation through DCUs is the most important as it accounts for almost 90 percent of the total public investment. The NDCUs such as agriculture, irrigation/tube well corporations, meat and poultry corporations/boards, forestry, fishery and tea corporations etc, owned by the central and the respective state government account for only 9 to 10 percent. A mere look at the CSO published series on Public Capital formation may mislead one to conclude that public capital formation in the agriculture has declined. It is worth re-iterating that CSO estimate mainly accounts for only investment made in major and medium irrigation schemes. Even in case of minor irrigation, majority of investments come from private household sector. Recent debate on the complementary relation between the public and private capital formation in agriculture has shown the concept of public capital formation in agriculture in new light. It is also true that Gross Capital Formation in agriculture (GCFA) as estimated by the NAS is not comprehensive in its coverage of investments in a large number of activities mentioned above. The present study is an attempt to re-estimate the public capital formation in agriculture and test its relation with the private capital formation in agriculture.

Before one proceeds to measure the estimate of public capital formation in agriculture, one needs to keep in mind that the definition of agriculture and allied activities adopted in the national accounting system is not the same as the one in the government's budgeting and planning processes. The National Income Accounts define agriculture sector as the one, which comprises agriculture proper, livestock and livestock products, forestry and logging, fishery and irrigation system[6]. On the other hand, 'agriculture and allied sector' covers all the activities that are included under the primary sector in the national income accounts with only exception of investment in major, medium and minor irrigation works. This broadly covers 11 heads of expenditures, namely, soil and water conservation, crop husbandry, animal husbandry, food-storage warehousing, dairy development, fisheries, forestry and wildlife, co-operation, agricultural research and education, investment in financial

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[6] ibid.p.1702

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institutions and other investments in agricultural programmes[7]. It may be noted that budgetary expenditures on procurement of food and its trade, ware housing and milk supply schemes and food processing are kept outside the scope of agriculture in the NAS definition. Similarly, the expenditure on storage and warehousing, crop engineering, animal husbandry, fishery, community participation and many others classified in the agriculture are apportioned in the heads like 'other economic services', 'agriculture, forestry, hunting and fishery services', and 'education' which are categorized by the economic and functional classification of government expenditure within the community, social and personal services industries of use in the NAS. Moreover, all the expenditures including that of agriculture incurred at the municipal and corporations level are put together in the public administrative services.

In the absence of a single consistent definition of capital formation in agriculture, estimating capital formation in agriculture is an onerous task, more so in the view of interdependence of investments in manufacturing and other industries of use with agriculture for the supply of agricultural inputs, processing, warehousing and rural development programme, MP local area development schemes, transport (roads) and railways. Though a comprehensive measure of capital formation in agriculture should consider all the broad heads, one runs into the danger of overestimation of the same in the absence of enough information for segregating the capital expenditures from these sectors that are really relevant for agriculture.

2.2 Construction of the Investment series

Capital investment in agriculture is made by individual households, private corporate sector as well as by the government departments. The first two categories comprise private investment, while third one is public investment. Private corporate sector comprises firms and co-operatives in sugar, milk, poultry, bee keeping, plantations, horticulture, floriculture, and other small and cottage agricultural

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[7] Government of India, Ministry of finance. 'Major and Minor Heads of Budget'pp.240-265

enterprises. In view of limited coverage of CSO series on public sector agricultural investment, we have tried to construct a new series of public investment that includes all possible items of investments relevant for agriculture. The heads of items included in the new series are –

Table 2.1: Name of different heads of expenditure considered in the estimation of public capital expenditure in agriculture

S. No	Name of different heads of Capital Expenditures
1)	Capital Outlay on Crop Husbandry
2)	Capital Outlay on Animal Husbandry
3)	Capital Outlay on Dairy Development
4)	Capital Outlay on Fisheries
5)	Capital Outlay on Forestry and Wild Life
6)	Capital Outlay on Soil and Water Conservation
7)	Capital Outlay on Plantation
8)	Capital Outlay on Special Area Programme
9)	Capital Outlay on Food Storage & Warehousing
10)	Capital Outlay on Agricultural Research and Education
11)	Investment in agricultural Financial Institutions
12)	Expenditure in Land Reforms
13)	Capital Outlay on Co-operation
14)	Capital Outlay on Rural Development Programme
15)	Capital Outlay on Drainage and Flood Control

16)	Capital Outlay on Command Area Development
17)	Capital Outlay on Minor Irrigation
18)	Capital Outlay on Medium and Major Irrigation
19)	Capital Outlay on Rural Electrification
20)	Capital Outlay on Rural Roads
21)	Capital Outlay on Fertilizer Industries

It is worth noting that expenditure in land reforms is not considered as part of capital expenditure in agriculture on many occasions, as it facilitates mere transfer of land from one set of farmers to the other. However, we have included the expenditure in the land reform as a part of total public capital formation in agriculture, as strong initiative from the government in land reforms implementation is quite often seen in many quarters as measures to give a boost to agricultural productivity.

Table 2.2: Private and Public Investment in Agriculture (both CSO and Broad Series) from 1960-61 to 2003-04 at 1993-94 prices

Years	CSO Public Investment (1993-94prices)	Broad Series Public investment 1993-94 prices	CSO Private Investment (1993-94prices)
1960-61	2400	5941	2858
1961-62	2440	6153	2675
1962-63	2833	6949	2792
1963-64	2945	7208	3184
1964-65	3119	7396	3440
1965-66	3276	7702	3954

1966-67	2857	7641	4359
1967-68	2849	8856	4981
1968-69	3162	9328	5288
1969-70	3158	8212	5761
1970-71	3216	8401	5371
1971-72	3478	8782	5669
1972-73	4212	10443	5865
1973-74	3983	8491	6331
1974-75	3691	16061	5876
1975-76	4185	20107	7038
1976-77	5566	14089	8599
1977-78	6191	14165	6877
1978-79	6848	14812	11131
1979-80	7141	17370	10217
1980-81	7301	17376	6932
1981-82	7130	18124	6949
1982-83	7092	17644	7437
1983-84	7196	18211	7529
1984-85	6921	18455	8027
1985-86	6213	17705	7919
1986-87	5864	17044	7844
1987-88	6045	14215	8249
1988-89	5699	12929	9063
1989-90	4972	12031	8452
1990-91	4992	13334	11424

1991-92	4376	13429	10589
1992-93	4539	12257	11602
1993-94	4918	15148	10331
1994-95	5369	15792	11416
1995-96	5322	12586	12367
1996-97	5150	13224	13176
1997-98	4503	13107	13791
1998-99	4444	13683	13026
1999-00	4756	14396	15268
2000-01	4435	13508	15374
2001-02	5488	14829	14872
2002-03	4760	15169	16740
2003-04	6191	14958	17994

Source: *National Account Statistics, various issues*
Budget Documents and Finance Accounts of Union Governments, 1960-61 to 2003-04

Table 2.3: per hectare Public Investment (both CSO and Broad Series) and Private Investment from 1960-61 to 2003-04 at 1993-94 prices.

Years	Per hectare Public investment (CSO series 1993-94 prices)	Per hectare Public investment (Broad series at 1993-94 prices)	Per hectare Private Investment (CSO series at 1993-94 prices)
1960-61	180	446	215
1961-62	180	454	198
1962-63	208	510	205

1963-64	216	528	233
1964-65	226	535	249
1965-66	241	565	290
1966-67	208	557	318
1967-68	204	633	356
1968-69	230	679	385
1969-70	228	592	415
1970-71	229	599	383
1971-72	249	629	406
1972-73	307	761	428
1973-74	280	596	445
1974-75	268	1166	426
1975-76	295	1419	497
1976-77	399	1010	617
1977-78	436	998	484
1978-79	479	1036	778
1979-80	514	1251	736
1980-81	521	1241	495
1981-82	502	1277	490
1982-83	506	1258	530
1983-84	504	1275	527
1984-85	491	1310	570
1985-86	441	1257	562
1986-87	420	1221	562
1987-88	451	1060	615

1988-89	402	911	639
1989-90	349	845	594
1990-91	349	932	799
1991-92	309	948	748
1992-93	318	859	813
1993-94	346	1064	726
1994-95	376	1105	799
1995-96	374	885	870
1996-97	361	926	923
1997-98	317	923	971
1998-99	312	960	914
1999-00	337	1020	1082
2000-01	314	957	1090
2001-02	388	1049	1052
2002-03	336	1071	1181
2003-04	437	1055	1269

Source: National Account Statistics, various issues
Budget Documents and Finance Accounts of Union Governments, 1960-61 to 2003-04
Statistical Abstract, various issues

The table-2.2 shows the CSO Public and Private Investment in agriculture and also the Broad Public Investment Series in agriculture at 1993-94 prices for the period of 1960-61 to 2003-04. The table clearly shows that public investment in agriculture both in CSO Series and Broad Series experienced decline in the 80's. The public capital formation in agriculture as per the CSO Series started falling since early 1980s'. The public capital formation in our broad series also experienced similar trend since mid 1980s after showing a trend of stagnancy during the period of early 1980s. Though both series have shown signs of revival

in the early 1990s', they again started falling since 1997. Though public capital formation in agriculture in broad series shows some occasional spurt after 2000-01, it was never quite like the trend witnessed in the early 1980s. Very much like public investment in agriculture, we have observed similar trend in the private investment in agriculture as it started its downward slide since the beginning of the 1980s. However, unlike public investment, it recovered in the late 1980s and continued its increasing trend till 2003-04 except some minor hiccups like the one in 2001-02. The capital formation in agriculture on per hectare basis on both public and private account gives the same scenario. The per hectare public investment in broad series started with Rs 446 in 1960-61 and remained largely stagnant till 1973-74. However, it recorded a surge and reached as high as Rs. 1419 in the 1975-76, the highest in the entire period 1960-61 till 2003-04. After 1976-77, it hovered around Rs. 1200 till mid 1980s and fell to Rs. 900 in the early 1990s and fluctuated between Rs. 900 and Rs1100 till 2003-04 for the most of the period. But, the per hectare CSO public investment in agriculture, which was Rs 180 in 1960-61, continued its steady march till 1983-84 after which it started slowing down and failed to recover till 2002-03. The year 2003-04 saw an abrupt rise in the per hectare CSO public investment in agriculture which is quite surprising in the context of the trend we witnessed in the broad series. This perhaps reflects the mere transfer of resources from other areas of expenditure in agriculture to irrigation. As far as private investment is concerned, the per hectare private investment in agriculture gave a very different picture from the one that we get from the trend of aggregate CSO private investment in agriculture. Unlike aggregate CSO private investment in table 2.2, the per hectare private investment in agriculture rose in the early 1980s and sustained its upward trend all through till 2003-04.

Trends of Public Investment (CSO & Broad) and Private Investment in Agriculture

Legend: Private Investment, Public Investment(CSO), Public investment (Broad)
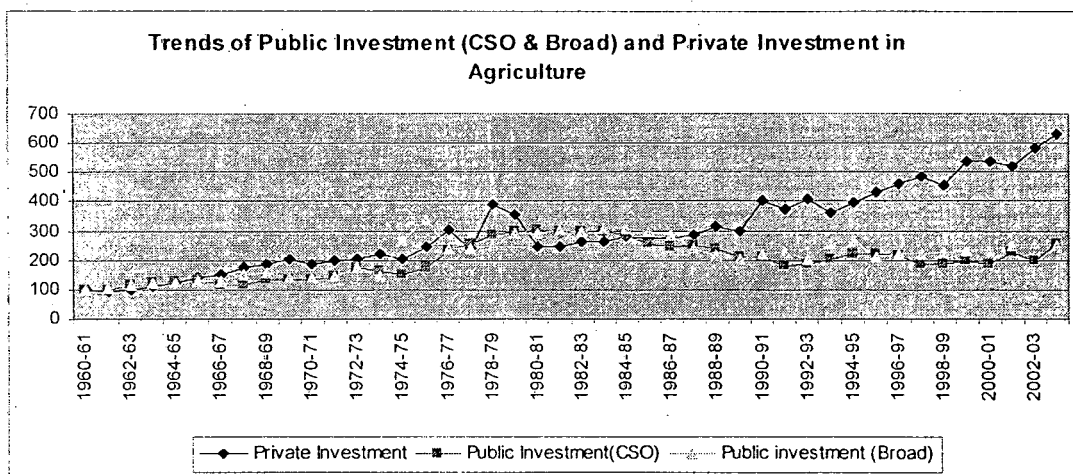
Graph 2.1: Trends of public investment (CSO & Broad) and private investment in Indian agriculture for the period 1960-61 to 2003-04

The graph 2.1 and 2.2 also show us a clear idea about the trend of public and private capital expenditure in Indian agriculture in last four decades. The graph 2.1 shows us an uninterrupted rising trend of private capital expenditure since mid 1980s where as both public (CSO) and public (Broad) either fell or remained stagnant for most pert of the last two decades. Similarly, the graph 2.2 shows the per hectare public (both CSO and Broad) and Private investment in agriculture move in opposite direction since late 1980s.

Per hectare public (CSO and Broad) and Private investment in agriculture

Legend: Public investment(CSO), Public investment(Broad), private investment
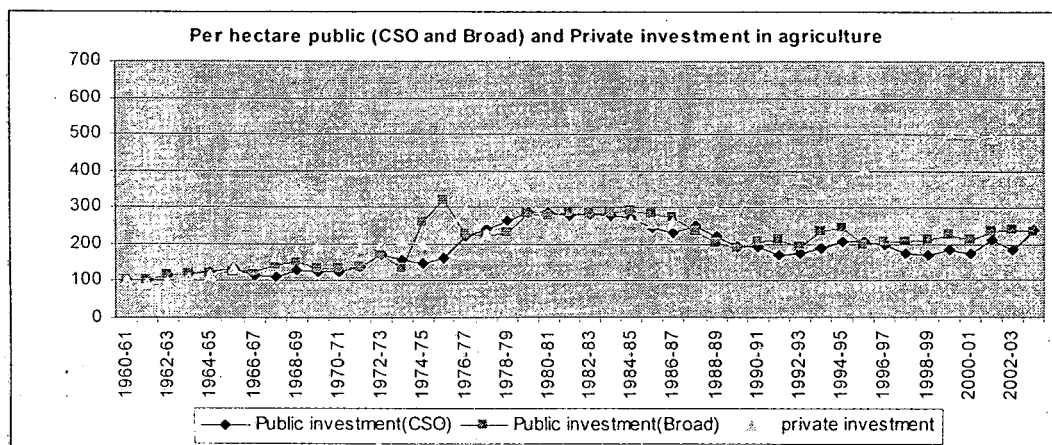
Graph2.2: Trends of public (CSO and Broad) and private investment per hectare in Indian
agriculture for the period 1960-61 to 2003-04

As discussed in our methodology part in the chapter 2, most of the literature (except Chand2000, 2001) examining the relationship between the public and private investment in Indian agriculture have used raw time series data. The use of

non-stationary data can lead to spurious relation if one does not give any treatment to the data. If two stationary variables are generated as independent random series, when one of those variables is regressed on the other, t-ratio on the slope coefficient would be expected not to be significantly different from zero, and the value of R square would be very low. However, if two variables are trending over time, a regression of one on the other could have a high R square even if the two are totally unrelated[1] .We have applied Augmented Dickey 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. We have tested stationarity of three series of investment in agriculture, namely, Public Investment Series (CSO), Public Investment Broad Series and Private Investment series and their first difference. The stationarity is tested by applying different lags up to five years and results are given below-

Table 2.4: Test of stationarity of time series on public and private investment in agriculture at 1993-94 prices

Lag	PUBCFA (CSO Series)	PRIVCFA	PUBCFA (Broad Series)	Critical Values (at 95% level)
ADF test Statistic				
Lag1	-1.535	-1.747	-2.109	-3.519
Lag3	-1.680	-1.147	-1.593	-3.525
Lag5	-1.910	-0.710	-1.598	-3.531

The above table shows the values of Augmented Dickey Fuller Statistic with lags of 1 year, 3 years and 5 years for all three series- Public Investment (CSO and Broad Series) and Private Investment Series. In all three cases, ADF values of all three series are found to be more than their critical values at 95% level of significance. Under such circumstances, we cannot reject our null hypothesis of non-stationarity. Once non-stationarity of the series is confirmed, we have conducted similar unit root test on their first differences to check their order of integration.

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[1] Chris Brooks: Introductory to for Finance, Cambridge University Press, 2002,p.282

Table 2.5: Test of stationarity of time series on 1st difference of public and private investment in agriculture at 1993-94 prices.

Lags	1st Difference PUBCFA (CSO Series)	PRICFA	PUBCFA (Broad Series)	Critical values (at 95%level)
	ADF Statistic			
Lag1	-4.055	-5.299	-6.319	-1.9490
Lag3	-2.425	-2.658	-3.519	-1.9495

However, the ADF values of first difference of all three series are found to be more negative than the critical values at 95%level of significance. i.e. all three series are found to be stationary at their first difference. It implies that all three series are integrated of order one. We can now examine the long run relationship between two series of public (both CSO and Broad) and private investment by applying co-integration between the two series. We have applied Engle-Granger two step procedures.

In the first step, we apply OLS to the two series of public and private investment with both public investment CSO series and the Broad Series taken one at a time and obtain the residuals in each case. We will proceed as follows:

Private Investment$_t$ = a + b Public Investment$_{t-1}$ + u$_t$

u$_t$ = Private Investment$_t$ – a – b Public Investment$_t$

In the second step, we test the stationarity of the residual terms just the same way as we did in case of the series of public and private investment. If U$_t$ is stationary, then the two series, i.e. public and private investment are co integrated; otherwise they do not have any long term relationship. In our exercise, we have calculated unit root values for the residuals of the regression of private investment on public investment (both CSO Series and Broad Series) with the assumption of different lags between the public and private investment.

Case1:--

Private Investment$_t$ = a + b CSOPublic Investment $_{t-1}$ + u$_t$

Private Investment$_t$ = a + bBrsPublic Investment$_{t-1}$ + u$_{tb}$

Case 2:-

Private Investment$_t$ = a + b CSOPublic Investment$_{t-3}$ + u$_t$

Private Investment$_t$ = a + b BrsPublic Investment$_{t-3}$ + u$_{tb}$

Case 3:-

Private Investment = a + b CSOPublic Investment $_{t-5}$ +u$_t$

Private Investment$_t$ = a + b BrsPublic Investment $_{t-5}$ + u$_{tb}$

Where, CSOPublic Investment and BrsPublic Investment denote public investment as per CSO estimate and our own broad estimate respectively.

Table2.6: Unit Root test of series on residuals derived from regression equation on public and private investments in agriculture at 1993-94 prices.

	Unit Root Values for the residual term		
	ADF test Statistic		95%Critical value
	Ut	U$_{tb}$	
Case-1	-1.1396	-1.6345	-3.5189
Case-2	-1.2524	-1.2707	-3.5247
Case-3	-1.2919	-0.8207	-3.5312

The unit root values in the above table show that ADF test statistic in all three cases for both CSO public investment and Broad Series are more than the critical values at the 95% level of significance. i.e. we can not reject the null hypothesis of non-stationarity in the residual terms. It infers that there is no long term relation between the public investment and private investment for both the Public CSO and Broad Series.

2.3 Structure and determinants of private investment in agriculture

In the last 50 years, private investment has emerged as an important component of capital formation in Indian agriculture, more so after fiscal austerity drive has become part of economic liberalization. Private sector investment in agriculture comprises of investments in the household sector and corporate sector – both organized and unorganized. The organized segment contains big firms, primarily in the plantation sector, and their estimates of capital formation are

available in their accounting book. The unorganized sector, however, does not have any such systematic information. They are basically private co-operatives like sugar, milk, poultry, etc and other very small and cottage agricultural enterprises (like dairy, agricultural, implements etc and not industries)[2]. Apart from information on the contribution of co-operatives to capital formation in Indian agriculture, CSO with the association of AIDIS, collect information on capital formation for household component. Household sector, which also includes the share of unorganized corporate sector and private co-operative, accounts for an overwhelming share of Private capital formation in agriculture. AIDIS shows the household capital formation in eight components:-

(a) land reclamation (b) bunding and other improvements (c) orchards and plantation (d) wells (e) other irrigation sources (f) agricultural implements, machinery and transport equipment etc (g) farm houses, barns and animal sheds (h) other capital expenditure.

The disparate movement of two series of capital formation on both public and private account since mid 1980s has brought to the fore the role that other factors may play in private capital formation in agriculture. It is hypothesized that apart from public investment, other factors like technology, institutional credit, terms of trade and cropping intensity and agricultural income also play an important part in the private capital formation in agriculture. We have tried to capture the impact of these factors on private capital formation in agriculture by running linear regression of private investment in agriculture on above factors with lags of 1year and 3 years of public capital formation of both CSO Series and Broad Series, taking one at time. We have run the regression exercise for two periods, viz, 1967-68 to 1984-85 and 1985-86 to 2003-04. The reason for dividing the entire period into two sub periods was the turn around in public sector investment since mid 1980s; the first sub period represents rising phase and the second sub-period represents declining phase of public sector investments. Though several measures of terms of trade are available, we have taken the ratio of price index of

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[2] Ashok Gulati and Seema Bathla, op cit, no3,p1698

agricultural products to price index of manufactured products with the base 1981-82=100. We have also used the area under HYV as proxy variable for technology. Another variable we have considered for analyzing the behavior of private investment in agriculture is Cropping Intensity (C.I.) that we have calculated by using the formula

C.I. = gross/net sown area * 100.

When we have used CSO Public Capital Formation in agriculture with lags of one year, three year as one of the explanatory variables, we have got the following results-

For the period 1967-68 to 1984-85,

$$PVTCFA_t = -7583.77 + 1.084\ CSOPUB_{t-1} + 0.142\ HYV\ Area_t - 1.258\ Credit_{t-1} + 0.262\ TOT_{t-1}$$

$$(-0.127) \quad (2.188)^{**} \qquad (0.148) \qquad (-2.520)^{**} \qquad (1.320)$$

$$-0.098 C.I._t + 0.939\ GDPA_{t-1} \qquad Adj\ R^2 = 0.625\ df = 17$$

$$(-0.107) \qquad (1.871)^{***} \qquad \text{--} 2.1$$

$$PVTCFA_t = -43714.5 + 0.080\ CSOPUB_{t-3} + 0.215\ HYV\ Area_t - 1.095\ Credit_{t-1} + 0.163 TOT_{t-1}$$

$$(-0.579) \quad (0.101) \qquad (0.173) \qquad (-1.280) \qquad (0.667)$$

$$+ 0.519\ C.I._t + 1.015 GDPA_{t-1} \qquad\qquad Adj\ R^2 = 0.463\ df = 17$$

$$(0.442) \qquad (1.791)^{***} \qquad \text{------------------------------------} 2.2$$

For the period 1985-86 to 2003-04,

$$PVTCFA_t = 51726.70 - 0.142\ CSOPUB_{t-1} + 0.617\ HYV\ Area_t + 0.683\ Credit_{t-1} + 0.014\ TOT_{t-1}$$

$$(1.192) \quad (-1.355) \qquad (1.40) \qquad (3.392)^{*} \qquad (0.320)$$

$$-0.403\ C.I._t - 0.013\ GDPA_{t-1} \quad Adj\ R^2 = 0.926\ df = 18$$

$$(-1.033) \qquad (-0.039) \qquad \text{------------------------------------} 2.3$$

$$PVTCFA_t = 15079.75 - 0.138\ CSOPUB_{t-3} + 0.335\ HYV\ Area_t + 0.671\ Credit_{t-1} - 0.043\ TOT_{t-1}$$

$$(0.362) \quad (-0.880) \qquad (0.605) \qquad (3.047)^{*} \qquad (-0.452)$$

$$- 0.056 \text{ C.I}_t. - 0.058 \text{ GDPA}_{t-1} \qquad\qquad \text{Adj R}^2 = 0.920 \text{ df}=18$$

(-0.134)　　(-0.168)　　--2.4

When Broad Public Capital Formation in agriculture with lags of one year and three years are used as one of the explanatory variable, we have got the following results-

For the period 1967-68 to 1984-85,

$$\text{PVTCFA}_t = -53964.9 + 0.471 \text{BRSPUB}_{t-1} - 0.228 \text{ HYV Area}_t - 1.045 \text{ Credit}_{t-1} + 0.224 \text{TOT}_{t-1}$$

　　　　(-0.851)　　　(1.389)　　(-0.208)　　　(-1.936) ***　　　(1.028)
　　+ 0.641 C.I$_t$ + 0.983 GDPA$_{t-1}$　　　　　　Adj R^2 =0.543 df= 17

　　　(0.671)　　(1.773) ***　　------------------------------------2.5

$$\text{PVTCFA}_t = -26900.4 + 0.564 \text{ BRSPUB}_{t-3} + 0.034 \text{ HYV Area}_t - 1.106 \text{ Credit}_{t-1} + 0.076 \text{ TOT}_{t-1}$$

　　　　(-0.429)　　　(1.622)　　　　　(0.032)　　　(-2.097) ***　　(0.357)
　　+ 0.294 C.I$_t$ + 0.983 GDPA$_{t-1}$　　　　　　Adj R^2 =0.566 df= 17

　　　(0.311)　　(1.783) ***　　------------------------------------2.6

For the period 1985-86 to 2003-04,

$$\text{PVTCFA}_t = 30599.38 - 0.048 \text{ BRSPUB}_{t-1} + 0.561 \text{HYV Area}_t + 0.634 \text{ Credit}_{t-1} - 0.009 \text{ TOT}_{t-1}$$

　　　(0.719)　　　(-0.505)　　　(1.186)　　　(2.806) **　　(-0.098)
　　-- 0.244 C.I$_t$ + 0.020 GDPA$_{t-1}$　　　　　Adj R^2 =0.917 df= 18

　　　(-0.624)　　(0.058)　　------------------------------------2.7

$$\text{PVTCFA}_t = 34061.79 - 0.189 \text{ BRSPUB}_{t-3} + 0.411 \text{HYV Area}_t + 0.813 \text{ Credit}_{t-1} + 0.010 \text{ TOT}_{t-1}$$

　　(0.915)　　(-1.783) ***　　(0.965)　　　(3.680)*　　　(0.126)

　　--0.218 C.I$_t$. - 0.140 GDPA$_t$　　　　　Adj R^2= 0.933 df=18

　　(-0.626)　　(-0.437)　　------------------------------------2.8

Where

PVTCFA = Private Fixed Capital Formation in agriculture

CSOPUB = Public Investment in agriculture as per the CSO Series (Rs Crore in 1993-94 prices)

BRSPUB= Public Investment in agriculture as per the Broad Series (Rs Crore in 1993-94 prices)

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Credit = Institutional finances (both direct and indirect credit to farmers for medium and long term) during the year.

GDPA= Agricultural GDP for the particular year.

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

The equations 2.1 to 2.4 show the effect of different factors including public capital formation in agriculture based on CSO series on private capital formation in agriculture for the two sub periods 1967-68 to 1984-85 and 1985-86 to 2003-04. In the period 1967-68 to 1984-85, public investment in agriculture with one year lag and agricultural income show to have significant positive effect on private investment in agriculture. When we increased the lag of public investment to three years, its effect on private investment in agriculture turned insignificant and agricultural income remained the only significant factor having positive impact on private investment. In the subsequent period, i.e, 1967-68 to 2003-04, the effects of public investment in agriculture with both one year and three years on private capital formation have shown to be negative but insignificant. However, institutional finances to agriculture have emerged as significant factor in the second phase.

In response to observations by some scholars that a broader measure of public capital formation in agriculture continues to show its stimulating effect on private capital formation in agriculture, we have checked such remarks with our own broad measure of public capital formation. The equations 2.5 to 2.8 capture the effect of broad series of public capital formation in agriculture with the lags of one year and three years on private capital formation for both the periods. However, the broad measure of public capital formation in agriculture also portrays roughly the same scenario as the CSO base one in our previous paragraph. The equations 2.5 and 2.6 show the effect of public investment in agriculture on private investment as positive but insignificant for the period 1967-68 to 1984-85 with agricultural income emerging as the only factor having any significant positive impact. But, the effect of public capital formation in

agriculture with three years lag on private capital formation was found to be negative and significant in the subsequent period. During that period, credit to agriculture has shown strong positive impact on capital formation in agriculture on private account. In the light of the above discussion, we can safely conclude that even a broad measure of public capital formation in agriculture has supported our hypothesis of weak complementary relation between the two types of capital formation in agriculture during the period 1985-86 to 2003-04.

Our discussion on private capital formation in agriculture would be incomplete without any reference to the credit that showed some bizarre behaviour during the first period. The negative effect of institutional credit to agriculture on private capital formation in agriculture seems incongruent in a period that was marked by the rapid expansion of rural banking following nationalization of commercial banks in 1969. The expansion of the rural banking during that period was probably not followed by the corresponding increase in the borrowings by majority of the farming community. The stringent regulation in loan sanction and collateral requirement implies that access to banking was only limited to land lord and money lenders who in turn lent to the small and marginal farmers at an exorbitant rate. Moreover, with easy availability of loans, the richer farmers perhaps found it to easier to disinvest in the farm sector and relocate themselves in the urban areas.

We have also tried to capture the changing dynamics of the relation between public investment and private investment in agriculture in the entire period 1960-61 to 2003-04 by estimating correlation coefficient between two series with different lags for two sub periods. The following table shows the results of the correlation coefficient between the Private investment and Public investment (both CSO Series and the Broad Series) with one, three and five years lag.

In the first sub period, i.e., for the period 1960-61 to 1984-85, the correlation coefficient between the public investment and private investment for all lags have turned out to be positive and significant for both the series of public

investment. However, the result turned out to be quite opposite in the subsequent sub period.

Table 2.7:-Correlation coefficient between Public Private Investment in agriculture.

Period	Correlation with CSO Series at 1993-94 prices	Correlation with the Broad Series at 1993-94 prices
	Lag1	Lag1
1960-61 to 1984-85	0.755*	0.786*
1985-86 to 2003-04	- 0.620*	-0.313
	Lag3	Lag3
1960-61 to 1984-85	0.596*	0.779*
1984-85 to 2003-04	-0.785*	-0.613*
	Lag5	Lag5
1960-61 to 1984-85	0.4 62**	0.507**
1980-81 to 2000-0	-0.855*	-0.686*

**, * signifies at 5%and 1% level of significance respectively.

To sum up, though the co integration test and the subsequent regression analysis and Bivariate Correlation analysis show that the hypothesis of complementary relation between the public and private Investment no longer seems to be valid in the context of Indian agriculture, we need to add some caveats here due to limitations on our methods and data. First of all, we have failed to account for a part of capital expenditure in agriculture, as we did not include financial assistances from foreign donors and part of expenditure in projects that was jointly funded by international agencies. Moreover, the variables chosen for our regression analysis may not be comprehensive. Mitra has rightly observed that we can not rush into conclusion that the relationship could be one of substitution or of independence between the two[3]. We, in fact, can not summarily reject the complementary hypothesis as the relation may still hold at the micro level or project level. But the result of our study confirms that public investment has ceased to be the major driving factor in the private capital formation in Indian agriculture in the last two decades. Government investment in major/medium and minor irrigation project is still the most important and

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[3] Ashok Mitra, op cit,no1,p.976

dominant component of total public capital formation in agriculture. It also cannot be denied that substantial amount of private investment in agriculture in terms of land development, machinery, implements and construction of dug-wells; tube-wells are basically induced by the massive government investment in irrigation to take advantage of the assured water supply in augmenting production and income. At the same time, that alone can not be the reason strong enough for making a sweeping generalization of all pervasive complementary relation between the public investment and private investment in agriculture at the macro level.

Chapter 3

Capital Formation in Agriculture -II

A state level analysis – Assam and West Bengal

Though the debate on complementarity of the relation between the public and private capital formation in agriculture first started at the all India level, it soon spilled over to the state level. This followed observations by some economists that the relation between the two types of capital formation in agriculture at the state level remained intact over the years even though the same can not be said at the national level. However, most of these arguments are largely based on aggregate analysis (all India) level and hence do not reflect the regional picture. This is more so when there exists substantial variation across states in terms of agricultural development as well as capital formation. As the debate gets intensified, several works on the same topic at the state level surfaced over the years. Of these, the work by Chand (2001), Dhawan and Yadav (1995), Roy and Pal (2002) and Thorat and Hazell (2000) are quite prominent. The opinions over the complementary relation between the public and private investment in agriculture at the state level, like at the national level, is divided. While most of the authors that includes Dhawan, Thorat, Hazell, Roy and Pal view that the complementary relation between the public and private investment in agriculture can be upheld even at the state level, Chand (1995,2001a,2001b) remained the only exception to doubt the veracity of the relation not just in the national level, but also in the state level.

Dhawan and Yadav (1995) was first of its kinds that made some efforts to examine the relation between the public and private capital formation in agriculture at the state level. Instead of the total private capital formation in agriculture, the authors preferred to concentrate on the private fixed capital formation in agriculture per cultivator household. Apart from examining the main components of Fixed Capital Formation in Agriculture, the authors made some concerted attempts to analyze the main determinants of FCFA. The authors observed that the significant

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role played by Canal irrigation, which is largely under public sector in India, in stimulating Private Fixed Capital Formation in agriculture confirmed the complementary relation between the types of the investment at the state level.

Chand (2001) has, however, refused to endorse the findings of Dhawan and Yadav. As a part of his efforts to verify the complementary relation between the public and private capital formation in agriculture, Chand extended the coverage of his study to the state level. At the state level, the author examined the relation between the public and private investment on the per hectare basis at two points 1981-82 and 1991-92. Chand didn't consider the state of Jammu and Kashmir while estimating the regression equation as the state receives special package from the central government for capital formation in agriculture.[1] The author found that already not so strong relation between the public and private capital formation in agriculture for the sixteen major states in 1981-82 has further weakened in the 1991-92 as the coefficient of public capital formation as one of the determinants of private capital formation in agriculture has gone done from 0.1651 to 0.064 over the decade.

Roy and Pal (2002) have argued for the active participation of the state in its agricultural development. In the paper, where the authors calculated both the intensity and growth of public and private investment for all the states and union territories for the period 1965 till 1989, the simultaneous equation model showed that the private investment in agriculture is highly dependent on the lagged values of the public investment. The authors also maintain that the limitation of the CSO data has undermined the impact of public investment in agriculture on the private investment in agriculture. They later conclude that the extension of data coverage to include heads of expenditure like rural roads, rural electrification with appropriate lags supports a strong positive association between the two types of investment.[2]

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[1] Ramesh Chand, op cit,no1,p176
[2] B.C.Roy and Suresh Pal. op.cit,no3,p.669

Hazell, Fan and Thorat (2000) made similar case in favour of public investment in agriculture. In the simultaneous equation model, the authors used three variables, viz, PUIR (Percentage of total cropped area that is irrigated), PRIR (Percentage of total cropped area under private irrigation) and PVELE (Percentage of rural villages electrified) to represent the public and private capital expenditure in agriculture with PUIR and PVELE representing the former and PRIR the later. The equation with PRIR as dependent variable and PUIR and PVELE as independent variables shows the role of the PUIR to be significant in stimulating PRIR[3].

The equation runs as follows –

PRIR = 0.017 + 0.918 PUIR +0.012PVELE

(2.23)*   (18.61)*   (0.87)

However, the result is far from comprehensive as it only considers expenditure on irrigation and rural electrification and leaves out a large chunk of expenditures on the public and private account relevant for agriculture.

The current chapter is an attempt to settle the debate over the complementary relation between the two types of capital formation at the state level. However, we choose to confine our coverage to only two states, namely Assam and West Bengal for a shorter period- 1981-82 to 2001-02 instead of the period 1960-61 to 2003-04 chosen for the national level for two reasons. *Firstly,* as already mentioned, we did so because of changing physical structure of the two states in the earlier period specially Assam before 1980s. *Secondly,* it is only since 1980s that the relation between the public and private investment in agriculture is believed to have changed. Though we have extended the coverage of our national level study to 2003-04, we are content with our coverage of the state level study only till 2001-02, the period when the latest All India Debt and Investment Survey was conducted.

3.1 Methodology

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[3]Shenggen Fan, Peter Hazell and S K Thorat, op cit,no1,p.3585

Since CSO series on public sector agricultural investment is available only at the national level with limited coverage, we have constructed a new series of public investment that includes most of the items of capital expenditure relevant for agriculture. We have relied on the finance accounts and appropriation accounts of both states for data on capital expenditure in agriculture on public account. Here, we have included the same heads of expenditure as we did for the estimation of broad series of public investment in agriculture at the national level (refer to table 3.1).

Capital expenditure in agriculture on private account is made by individual households and private corporate sector. Though CSO provides time series information on private capital formation in agriculture at the country level, it does not provide any such information at the state level.However; the RBI-NSSO has been conducting country-wide survey (All India Debt and Investment Surveys) at decennial intervals to assess debt and investment of the household sector since 1951-52, both at national level and state level. These surveys give rich information on fixed capital expenditure by rural and urban households at the state level as well. But, information provided by the AIDIS on private investment in agriculture is not comprehensive as it does not contain private corporate investment. The private corporate investment in agriculture doesn't account for more than 5 percent in total private investment in agriculture. To that extent, total private investment in agriculture has been underestimated. We have used the All India Debt and Investment Surveys, 1981-82, 1991-92 and recently published 2001-02 and interpolated these three data points to get the complete time series of private investment in agriculture. It is worth mentioning that we have mainly used the graphic method and the simple growth rate to interpolate the values of private capital expenditure for the intermediate years.

Very much like our exercise at the national level, we have used the Unit Root Test to assess the stationarity of the time series of both public and private investment series for both the states, i.e. Assam and West Bengal and followed it with Engle-Granger two step procedures to ascertain whether any relationship exists

between the two series of investment. We have also run regression with private investment as dependent variable and public investment as independent variable in an attempt to quantify the significance of public investment in stimulating capital formation in agriculture on private account.

3.2 Trends in Public and Private Sector Investment in Agriculture- Assam and West Bengal:

Our estimates of public and private investment in agriculture in both the states are presented in both absolute amount and on per hectare basis at constant prices (in 1993-94 prices) in table 3.1 and 3.2.

Table 3.1: Public and private capital expenditure in agriculture in the state of Assam and West Bengal for the period 1981-82 to 2001-02 at 1993-94 prices

	West Bengal		Assam	
Years	Public Capital Expenditure at 1993-94 prices (in Rs lakhs)	Private Capital Expenditure at 1993-94 prices (in Rs lakhs)	Public Capital Expenditure at 1993-94 prices (Rs lakhs)	Private Capital Expenditure at 1993-94 prices (in Rs lakhs)
1981-82	27191	10481	24797	3881
1982-83	20322	11352	17429	3747
1983-84	18450	11521	20934	3619
1984-85	20121	13190	25493	3446
1985-86	14296	11453	21963	3234
1986-87	20124	11775	24459	3222
1987-88	23968	12195	27759	3018
1988-89	19317	12135	18688	2835
1989-90	17283	11991	19569	2585
1990-91	20317	11801	19689	2435
1991-92	18034	11161	22443	2238
1992-93	11481	10620	14486	2308
1993-94	18778	10495	14832	2429
1994-95	19423	10050	13673	2396
1995-96	18172	9741	11555	2436
1996-97	21585	9165	9819	2395
1997-98	21003	9042	13013	2465

1998-99	20782	8795	11672	2492
1999-00	25006	8732	14432	2575
2000-01	31659	8816	21775	2556
2001-02	28840	8647	19088	2590

Source: Budgets of Assam and West Bengal for the years 1980-81 to 2001-02
All India Debt and Investment Survey, 1981-82, 1991-92, 2002-03.

Table 3.2: Per hectare public and private capital expenditure in agriculture in the state of Assam and West Bengal.

| Years | West Bengal | | Assam | |
	Per hectare Public Capital Expenditure at 1993-94 prices (in Rupees)	Per hectare Private Capital Expenditure at 1993-94 prices (in Rupees)	Per hectare Public Capital Expenditure at 1993-94 prices (in Rupees)	Per hectare Private Capital Expenditure at 1993-94 prices (in Rupees)
1981-82	489	188	916	143
1982-83	365	208	644	138
1983-84	345	218	774	134
1984-85	377	235	942	127
1985-86	268	232	812	120
1986-87	377	235	904	116
1987-88	449	234	1026	112
1988-89	362	239	691	105
1989-90	324	229	723	97
1990-91	381	224	728	91
1991-92	338	209	830	83
1992-93	210	198	535	85
1993-94	344	189	548	90
1994-95	356	189	505	91
1995-96	333	183	416	94
1996-97	395	170	358	93
1997-98	386	167	474	94
1998-99	382	161	432	94
1999-00	457	158	534	93
2000-01	578	158	799	96
2001-02	527	158	701	96

Source: Budgets of Assam and West Bengal for the years 1980-81 to 2001-02
All India Debt and Investment Survey, 1981-82, 1991-92, 2002-03.

The table 3.1 shows that public investment in agriculture (at 1993-94prices) in the state of West Bengal started its declining trend since 1981-82. Except some occasional spurts, the period 1985 till 1995 is marked by total stagnancy or decline

in the public expenditure in the state's agriculture. However, it recovered since 1999-00 to record as high as Rs 31659 lakhs in the year 2000-01, the highest in the entire two decades period. The public capital expenditure in agriculture on per hectare basis in the state also displays the same scenario. The per hectare public expenditure in agriculture , which was Rs 489 in 1981-82, remained below Rs 400 for most of the period before it started rising since 1999-00. However, the year 1987-88 remained the only exception with public capital expenditure in agriculture, both in total and per hectare basis, recording Rs 23968 lakhs and Rs 449 respectively.

The trend of public capital expenditure in agriculture in Assam is somewhat different from West Bengal as public expenditure in agriculture started declining from only late 1980s. However, quite unlike West Bengal, its declining trend continued throughout 1990s. Though public expenditure has shown increasing trend since 1999-00, it never recovered enough to match the level of expenditure in the mid 1980s. The per hectare public expenditure in the states' agriculture, which was Rs916 in 1981-82, started declining since 1988-89 and later recovered enough to take it to Rs 700 per hectare in 2001-02. Very much like the state of West Bengal, the year 1987-88 saw unusually high public expenditure in the states' agriculture with total public expenditure and per hectare expenditure both reaching Rs27759lakhs and Rs1025.82 respectively, which is the highest in the entire period.

The private capital expenditure in agriculture in the state of West Bengal showed two trends. While the private expenditure either increased or remained stagnant in the 1st phase, i.e., from 1981-82 to 1991-92, the 2nd phase saw steady decline in private expenditure from Rs11161 lakhs in 1991-92 to Rs 8647 lakhs in 2001-02. In terms of per hectare private capital expenditure at 1993-94 prices, private capital expenditure rise from Rs 188.33 in 1981-82 to reach Rs 239.32 in 1988-89 after which downward slide started and it never recovered till 2001-02 when per hectare private capital expenditure was Rs 158.03. Even though public capital expenditure in the state's agricultural sector recovered in the late 90s, the

same didn't happen in the private capital expenditure. As for private capital expenditure in agriculture in Assam, the downward trend of private capital expenditure continued throughout 80s and 90s with slight hint of some recovery towards the end of the 90s. The private capital expenditure, which was Rs 3881 lakhs in 1981-82, fell to as low as Rs 2238 lakhs in1991-92 and later made moderate recovery to register Rs 2590 in 2001-02. The trend of per hectare private capital expenditure in agriculture also portrays the same story. The per hectare private capital expenditure in agriculture in the state was Rs 143.44 in 1981-82 which fell to Rs 82.69 in 1991-92 and later recovered enough to record Rs 95.89 in 2001-02. The private capital expenditure in the state both in terms of total expenditure and per hectare expenditure reaches its nadir in1991-92. This is also a period that marked the beginning of some recovery for the later period. The graph 3.1 and 3.2 also give us a good idea about the over all trend of the public and private capital expenditure in agriculture for both the states West Bengal and Assam for the two decades respectively. The graph 3.1 shows that the public expenditure in agriculture in the state of West Bengal has recovered since 1992-93 after a prolonged slump, but the private capital expenditure in the state continued its downward movement right till 2001-02. The graph 3.2 shows that like West Bengal, Assam also recorded some rise in the public capital expenditure in

Trends of Public and Private Investment in Agriculture (West Bengal)

—◆— Public Investment —▩— Private Investment
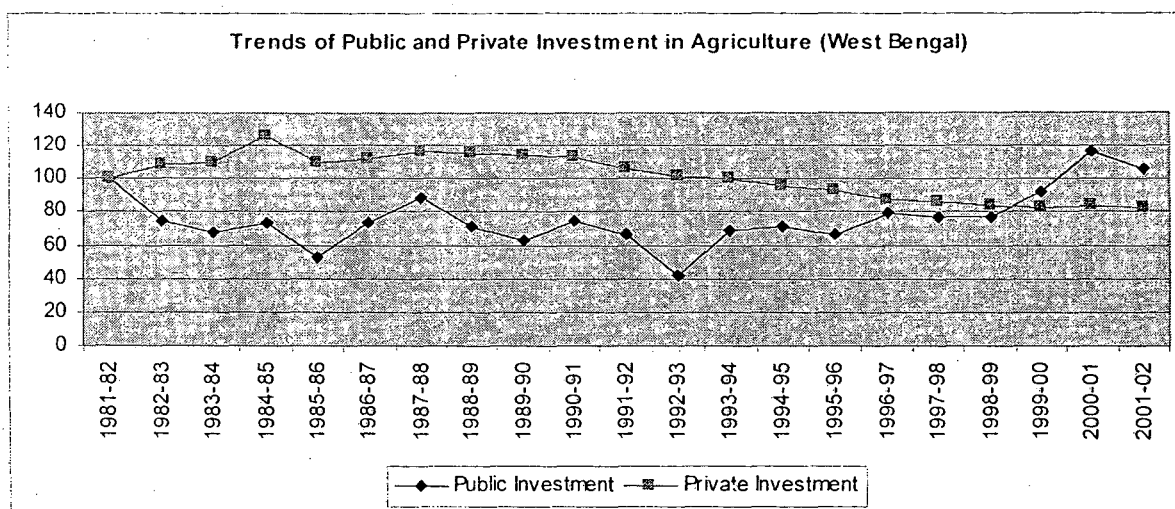
Graph 3.1: Trends of public and private investment in agriculture (West Bengal) for the period1981-82 to 2001-02.

Trends of Public and Private Investment in Agriculture (Assam)
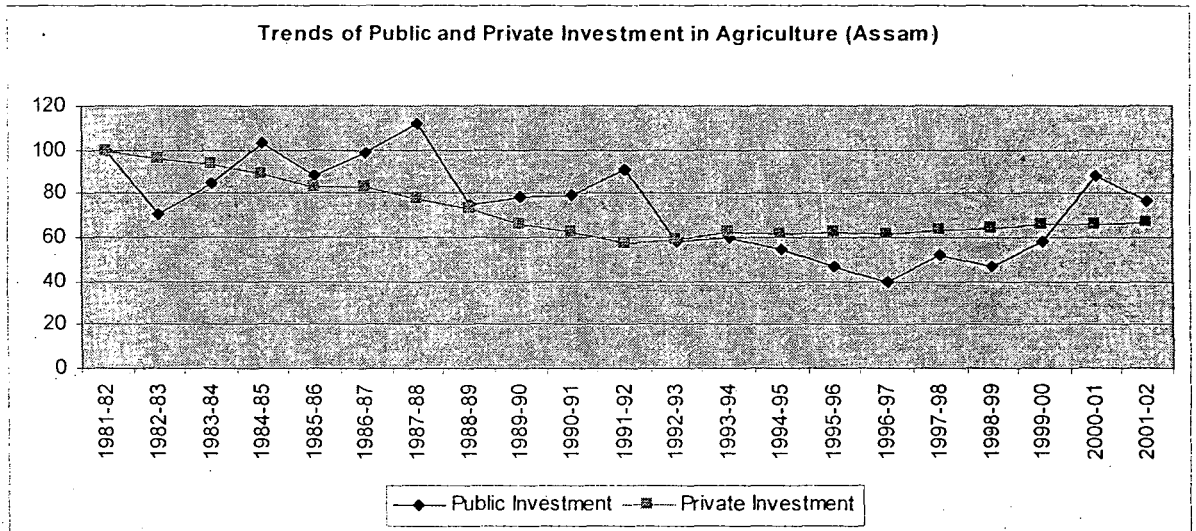
Graph 3.2: Trends of Public and Private Investment in Agriculture (West Bengal) for the period 1981-82 to 2001-02

Trends of Public and Private Investment per hectare in Agriculture (West Bengal)
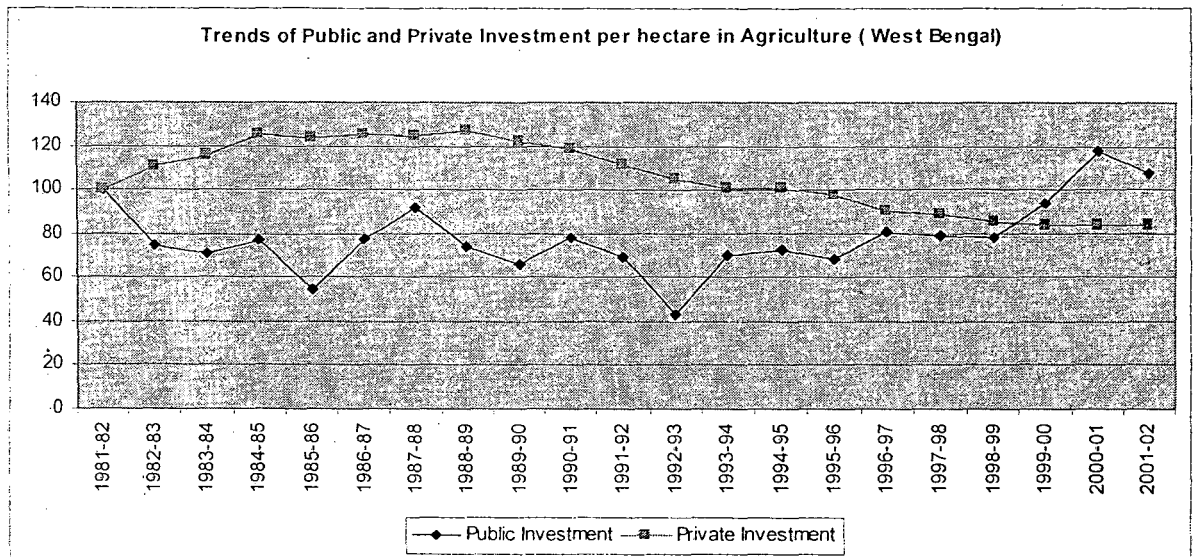
Graph 3.3: Trends of per hectare public and private investment in agriculture (West Bengal)

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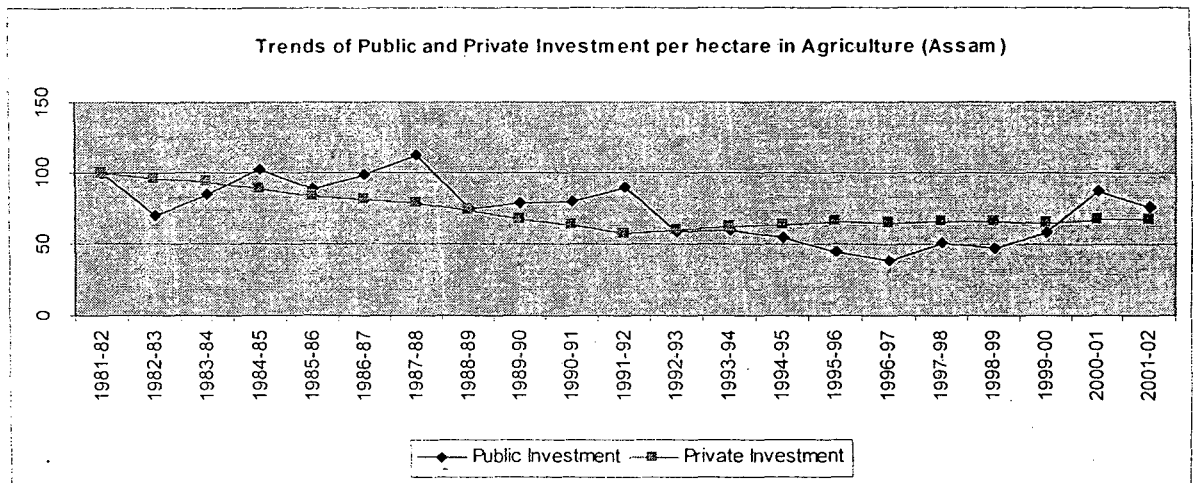
Graph 3.4: Trends of per hectare public and private investment in agriculture (Assam)

agriculture since mid 1990s after a long period of fall, which is also marked by occasional rise. However, the trend of private capital expenditure in agriculture virtually remained stagnant in the state after 1992-93. The graph 3.3 and 3.4 depict similar trends of per hectare public and private capital expenditure in agriculture in the state of West Bengal and Assam.

As stated earlier, the use of non-stationary data in regression analysis can have misleading conclusion. To avoid such spurious regression, we need to test the stationarity of the two series public and private investment in agriculture in both the states. Here again, we have applied Augmented Dickey 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. We have tested stationarity of two series of investment in agriculture, namely, Public Investment Series and Private Investment series and their first

differences. We have first checked the stationarity of the both the series of public and private capital formation in agriculture in the state of West Bengal and later replicated it in Assam. The stationarity is tested by applying different lags up to five years and results are given below-

Table 3.3: Test of stationarity of time series on public and private investment in agriculture in the state of West Bengal at 1993-94 prices.

Lags	Public investment	Private investment	Critical values (at 95% level)
ADF test Statistic			
Lag1	-1.939	-3.200	-3.675
Lag3	-0.656	-1.155	-3.712
Lag5	0.316	-2.658	-3.761

The table 3.3 shows the values of Augmented Dickey Fuller Statistic with lags up to five years for both the series of Public Investment and Private Investment in West Bengal agriculture. In all three cases, ADF values of both the series are found to be more than their critical values at 95% level of significance. Under such circumstances, we cannot reject our null hypothesis of non-stationarity. Once non-stationarity of the series is confirmed, we have conducted similar unit root test on their first differences to check their order of integration.

Similarly, we have conducted the stationarity test on the series of public and private investment in agriculture in Assam. The following is the result of the test of stationarity of both the series with different lags.

Table 3.4: The values of ADF statistic of Public and Private Investment in agriculture in the state of Assam at 1993-94 prices.

Lags	Public investment	Private investment	Critical values (at 95% level)
ADF test Statistic			
Lag1	-1.869	-0.825	-3.675
Lag3	-1.125	-0.989	-3.712
Lag5	-0.845	-1.614	-3.761

The above table shows the values of Augmented Dickey Fuller Statistic with lags up to five years for both the series of Public Investment and Private Investment. In all three cases, ADF values of both the series are found to be more than their critical values at 95% level of significance. Under such circumstances, we cannot reject our null hypothesis of non-stationarity. Once non-stationarity of the series is confirmed, we have conducted similar unit root test on their first differences to check their order of integration.

Table 3.5: The values of ADF statistic of 1st difference of public and private investment in West Bengal agriculture at 1993-94 prices.

Lags	1st Difference		Critical values
	Public Investment	Private Investment	(at 95% level)
	ADF Statistic		
Lag1	-5.238	-2.801	-1.963
Lag3	-2.084	-0.739	-1.966

However, the ADF values of first difference of both the series of investment in West Bengal are found to be more negative than the critical values at 95%level of significance. i.e. both of them are found to be stationary at their first difference. It implies that the two series are integrated of order one. We have carried out similar exercise on the series of public and private investment in agriculture in Assam. The following is the result of ADF test on the 1st difference of both the series.

Table 3.6: The values of ADF statistic of 1st difference of public and private investment in Assam agriculture at 1993-94 prices.

Lags	1st Difference		Critical values
	Public Investment	Private Investment	(at 95% level)
	ADF Statistic		
Lag1	-4.299	-2.442	-1.963
Lag3	-1.066	-0.709	-1.966

Very much like West Bengal, the ADF values of first difference of both the series of investment in Assam are found to be more negative than the critical values at 95%level of significance. i.e. both of them are found to be stationary at their first difference. It implies that the two series are integrated of order one. We can now

examine the long run relationship between two series of public and private investment by applying co-integration between the two series in both the states. We have opted for Engle-Granger two step procedures to test the co-integration between the two series.

In the first step, we have applied OLS to the two series of Public and Private Investment and obtained the residuals in each case. We have proceeded as follows:

Private Investment$_t$ = a + b Public Investment$_{t-1}$ + u$_t$

u$_t$ = Private Investment$_t$ - a - b Public Investment$_{t-1}$

In the second step, we test the stationarity of the residual terms just the same way as we did in case of the series of Public and Private Investment. If U$_t$ is stationary, then the two series, i.e. Public and Private Investment are co-integrated otherwise they do not have any long term relationship. In our exercise, we have calculated unit root values for the residuals of the regression of Private investment on Public investment with the assumption of different lags between the public and private investment.

Case1:--

Private Investment$_t$ = a + b Public Investment $_{t-1}$ + u$_t$

Case 2:-

Private Investment$_t$ = a + b Public Investment$_{t-3}$ + u$_t$

Case 3:-

Private Investment$_t$ = a + b Public Investment $_{t-5}$ + u$_t$

Table 3.7: Unit Root test of Series on residuals derived from regression equation on public and private investments in agriculture at 1993-94 prices.

Unit Root Values for the residual term		
ADF test Statistic		95%Critical value
West Bengal	Assam	
Case1 -2.068	-2.541	-3.675
Case 2 -0.551	-1.799	-3.712
Case 3 0.217	-1.501	-3.761

The unit root value in the table 3.5 shows that ADF test statistic of residual terms in all three cases for both Assam and West Bengal are more than the critical values at the 95% level of significance. i.e. we can not reject the null hypothesis of non-stationarity in the residual terms.

The movements of two series of capital formation on both public and private account in both the states are not same, as evident from the result of correlation coefficient between the two with different lags.

Table 3.8: Result of correlation coefficient between the series of public and private capital formation in agriculture in the state of Assam and West Bengal with different lags for the period 1980-81 to 2000-01.

Result of Pearson's Correlation Coefficient		
Lags	West Bengal	Assam
Lag1	-0.649*	0.612*
Lag3	-0.614*	0.805*
Lag5	-0.804*	0.753*

* signifies significance at 1 %level of significance.

The correlation coefficient between the public and private capital formation in the state of West Bengal is a complete contrast to the same in the state of Assam. While correlation coefficient between the public and private investment in West Bengal are found to be negative with lags of 1 year, 3 years and 5 years, it is found to be positive and significant at all three lags for Assam. The difference in the trends of capital formation in the public and private account in West Bengal throughout the period highlighted the role that other factors may play in private capital formation in agriculture. Theoretically, it is believed that apart from public investment, other factors like technology, institutional credit, terms of trade, cost of production play an important part in the private capital formation in agriculture. We have tried to capture the impact of these factors on private capital formation in agriculture by running multiple regression of private investment in agriculture on above factors with lags of 1year, and 3years of public capital formation. We have also used the area under HYV as proxy variable for technology. Another variable we have

considered for analyzing the behavior of private investment in agriculture is the cost of cultivation in per quintal paddy produced. Since Paddy is the major crop in both the states, we have treated it as the representative of over all cost structure in the agriculture. When we have used public capital formation in agriculture with lags of one year and three years as one of the explanatory variables, we have got the following results-

$$PVTCFA_t = 14132.61 - 0.006\ PUBCFA_{t-1} - 1.536\ COP_{t-1} + 0.093\ HYV_{t-1} +$$
$$(10.440)^* \quad (-0.059) \quad\quad (-3.237)^* \quad\quad (0.239)$$

$$0.526\ CREDIT_{t-1} \quad \text{----------------------------------- 4.1}$$
$$(1.624)\ ^{***}$$

$$\text{d.f.} = 19\ R^2 = 0.911$$

$$PVTCFA_t = 14436.193 + 0.086\ PUBCFA_{t-3} - 0.897\ COP_{t-1} - 0.425\ HYV_{t-1} +$$
$$(10.250)^* \quad (1.132) \quad\quad (-1.482)\ ^{***} \quad (-0.874)$$

$$0.393\ CREDIT_{t-1} \quad \text{------------------------------ 4.2}$$
$$(1.451)\ ^{***} \quad\quad\quad\quad \text{d.f.} = 17\ R^2 = 0.942$$

Where,

PVTCFA = Private Fixed Capital Formation in agriculture in West Bengal
(Rs Crore in 1993-94 prices)

PUBCFA = Public Fixed Capital Formation in agriculture in West Bengal (Rs
Crore in 1993-94 prices)

Credit = Institutional finances (both direct and indirect credit to farmers
for medium and long terms).

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

The sign of the coefficient of lagged public investment changed from negative to positive as we extend the lag of public investment from one year to three years. Public investment perhaps takes longer duration than just one year to get its stimulating effect fully magnified on the private investment. However, institutional credit to agriculture has emerged as more important player in encouraging private investment in agriculture. As expected, the cost of production has negative coefficient implying that increase in cost of farming discourage private investment

in the sector. The role of technology, represented by the indicator of area under HYV in promoting private investment in agriculture is found to be quite ambiguous and weak as vindicated by changing sign and insignificance of the coefficient on both occasions. Our regression exercise clearly shows that public investment in agriculture ceased to be major stimulator of private investment in agriculture in the state of West Bengal.

We have carried out similar exercise for the state of Assam with the same variables which gave the following results

$$PVTCFA_t = 5174.340 + 0.005\ PUBCFA_{t-1} + 1.094\ COP_{t-1} - 2.572\ HYV_{t-1} +$$
$$\quad\quad (6.854)^* \quad\quad (0.024) \quad\quad\quad (1.550)^{***} \quad\quad (-4.483)^*$$
$$\quad\quad 0.854\ CREDIT_{t-1} \quad\quad \text{------------------------------------ 4.3}$$
$$\quad\quad (1.365)^{***}$$
$$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad d.f. = 19\ R^2 = 0.721$$

$$PVTCFA_t = 5345.21 - 0.376\ PUBCFA_{t-3} + 0.766\ COP_{t-1} - 2.593\ HYV_{t-1} +$$
$$\quad\quad (7.511)^* \quad\quad (-1.263) \quad\quad\quad (1.005) \quad\quad (-3.991)^*$$
$$\quad\quad 0.933\ CREDIT_{t-1} \quad\quad \text{------------------------------------4.4}$$
$$\quad\quad (1.645)^{***}$$

$$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad d.f. = 17\ R^2 = 0.663$$

*, ** and *** signify the level of significance at 10 percent, 5 percent and 1 percent respectively.

Very much like West Bengal, credit is found to be more prominent factor than public investment in stimulating private investment in Assam's agriculture. However, quite unlike West Bengal, cost of production per quintal is positively linked to private investment. Perhaps, increase in the cost of production, resulting from increased mechanization leads to concomitant increase in amount of investment required for higher productivity. Though the coefficient of public capital formation in agriculture has turned negative as we extend the lag of public investment, it was found to be insignificant on both occasions.

To sum up, the co-integration test and the subsequent multiple regression analysis and Bivariate Correlation analysis show that the hypothesis of complementary relation between the public and private investment in agriculture is

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not vindicated in the Assam and West Bengal agriculture. However, the finding is not compelling enough to summarily reject the complementary hypothesis as the relation may still hold at the micro level or project level. At the same time, we need to admit limitations on our methodology and data. Very much like our national level study, our research at the state level is not free from limitations. Infact, the problems of data limitations in the state level is more pronounced than at the national level. Though we can get the information about the private capital expenditure in agriculture at the state level from AIDIS, it does not include the private corporate investment in its estimation of capital expenditure in agriculture. Moreover, AIDIS furnish information on the private capital formation in agriculture once in a decade. To the extent we have smoothed out fluctuations in the private capital expenditure in our interpolation of data for the interval period, it has its effect on our result. Apart from that, we have failed to incorporate financial assistances that a state government may receive from the central government for centrally and some jointly funded projects. Under such circumstances, it may be inappropriate to rush on any comment regarding the relation between public capital formation and private capital formation in agriculture.

We can at best confirm that public investment has ceased to be a major driving factor in the private capital formation in eastern part of Indian agriculture, ie, Assam and West Bengal. Government investment in major /medium and minor irrigation project is still the most important and dominant component of total public capital formation in agriculture. As stated earlier, massive government investment in irrigation is bound to encourage substantial amount of Private investment in agriculture in terms of land development, machinery, implements and construction of dug-wells; tube-wells.[4] Moreover, the relation between the two types of investment is complex one that differs depending on the different regional setting[5]. In states, located in the North-eastern part of India like Assam, which receive huge central funds as part of special package and private initiative is not quite strong, the

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[4] Ashok Mitra, op cit,no2,p.976

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relation between the two is generally stronger than other parts of India. In major part of eastern regions of India, commercialization of agriculture is very low as compared to other parts of India, particularly western regions. Private initiative in agriculture in this region is negligible and largely immune to any influence from the investment on public account. In such a setting, a weak relation between the public and private capital formation in just two decades is not compelling enough to draw a generalized conclusion about the relation between the two types of investment.

[5] Ramesh Chand, op cit,no2,p172

Chapter 4

A comparative study on capital formation in agriculture

Between Assam and West Bengal

One of the major problems of agriculture in developing countries is the low level of capital formation. The economic literature has numerous hypotheses on low capital formation in such economies. Among them, the observations by Nurkse, Lewis and Singer are prominent.Ragner Nurkse looked at it as the problem of both demand side as well as supply side. In other words, both the incentive and ability to invest are weak, because the domestic market is narrow and domestic savings are meagre[1]. Arthur Lewis defined low investment and low savings as problem of small ratio of profit to national income[2]. According to Hans Singer, it is the lack of investment opportunities which inhibits the people's desire to save and invest[3]. Given the heterogeneity of developing countries and different sectors within an economy, these generalizations are of little use. There are far too many factors in operation in traditional agriculture to be explained through such simple hypotheses. The traditional agriculture has certain peculiarities which influence the investment behavior of the farmers and therefore call for a through examination of the same rather than making sweeping generalizations. However, such literature on Indian agriculture, particularly at the state level, is conspicuous by its absence. Of the few such literature, following are worth mentioning- Panikar (1969), Chattopadhay (1965), Singh and Bokil (1965) and Dhawan and Yadav (1995).

Panikar (1969) looked at the asset structure and its composition of a typical cultivating family at two intervals 1951 and 1961 to shed some lights on the question of its traditionality. He also made an appraisal of components of capital expenditure in farm business over the same period. Panikar gave the impression that the components

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[1] Ragner Nurkse: Problems of Capital Formation in Underdeveloped countries, Basil Blackwell, 1962, p5.

[2] W Arthur Lewis: The Theory of Economic Growth, George Allen & Unwin, 1957,pp.226-227

of capital formation continue to be of predominantly traditional type and there was no perceptible change indicative of a transformation in agricultural technology between 1951-52 and 1961-62. The author offered his own hypotheses that low investment in traditional agriculture is due to its backward technology. In other words, quantity of capital invested is a function of its quality. With the emergence of new technology, high returns of such technology appeal to the wealthy farmers and attract more capital into agriculture. To examine his hypothesis, Panikar carried out an empirical survey at the state level, where he divided the states into two level- one with higher than national level of capital formation and the other with lower than national level of capital formation and compared the two groups on characterestics like value of tangible wealth per household, percentage share of land, house property, livestock and durable household assets and equipments used in farm and non-farm business. He also took a close look at the indicators that symbolize technological progress like iron plough, oil engines, electric pumps and tractors at the state level on the basis of livestock survey,1956. In the end, though the author contended that the supply of technology determines the level of capital formation[4], he failed to justify why other factors like rate of interest and income level should not be looked as determinants of capital formation.

Suhas Chattopadhay (1965) also made similar effort. The author used NSSO Socio-Economic Survey and All India Rural Credit Survey to calculate the household capital expenditure in farm business. Apart from estimates of expenditure on land and buildings, tools and implements, vehicle, power driven equipments, durable goods and livestock, Chattopadhay used RBI Survey to compare fixed capital formation in farm business during July 1961 to June 1962. He, thereafter, calculated ranks of the states on the basis of per acre and per hectare co-operative credit and Kendall's rank correlation coefficient between them and capital expenditure in farm business. Contrary to Panikar, Chattopadhay found the institutional credit to be an important factor (correlation

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[3] Hans Singer : International Development, McGraw Hill Book Company, 1964,pp27-28
[4] P.G.K.Panikar: " Capital Formation in Indian Agriculture", *Indian Journal of Agricultural Economics,* Vol24,No1,1969,p.44

coefficient is over 0.50)[5].

D Singh and Bokil (1965) is another good effort to make a component wise comparison of the level of investment and the cost of cultivation of cotton, oil seeds and rotation crops in the states of Punjab, Gujarat, Maharashtra and Mysore. Instead of going for the statewide study, the authors opted to use two stage stratified random sampling design with village as the primary sampling unit and the holding as the second stage unit within a district that served as strata. They also conducted the farm level study by dividing the farms into three types- small, medium and large depending on the farm size. The authors calculated the number and values of draught and cart per holdings and major/minor equipment per holding, farm structure and total investment per holding for each class of farmer in all four states. They found large scale variation in the farm level investment for each class both within and across the states.

Dhawan and Yadav (1995) have made some detailed enquiry into the components of private fixed capital expenditure at the state level on the basis of All India Debt and Investment Survey, 1981. They made a comparative study of allocation of total fixed capital expenditure and also irrigation investment and Fixed capital formation in agriculture per cultivator in major states. However, as their study is based on one point, i.e., 1981, it failed to give a dynamic scenario of changing capital formation in agriculture.

However, the above literature on capital formation is not comprehensive on two accounts. Firstly, most of the literature deals with the private component of fixed capital formation. They have failed to give a similar account of component wise public capital expenditure at the state level. Moreover, even the state level study of component wise private capital expenditure is far too short a period to give a complete scenario of the same. The current chapter is a complement over the earlier efforts as it covers two decades and used three surveys of AIDIS, including the recently published vey of 2002-03.Moreover, the chapter is not just confined to the domain of private capital

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[5] Suhas Chattopadhay: Agricultural Capital Formation and its relation to Credit Facilities in India,

expenditure, as it gives the same component wise treatment to public capital expenditure under the budget accounts of both the states, Assam and West Bengal. In a way, it will give some hints of what goes into making one state, namely West Bengal an impressive performer in agriculture in comparison to Assam in the last two decades.

4.1 A comparative study of private capital formation in agriculture

A close examination of the asset composition of rural households in both the states in the last two decades and the same on the public account under state budgets will give a clear picture of the pattern of investment and *ipso facto*, analytical framework of the factors behind the variances in the performance of agricultural sector in the two states. First of all, we have tried to make a comparative study of the asset composition of the private capital expenditure in agriculture in both the states in the last two decades. To get a broad picture of the asset composition in the farm sector, we made a broad categorization of the assets in the following heads, viz, improvement/reclamation of land, orchards & plantations, farm houses and other constituent, wells and other irrigation resources. However, we have preferred to focus on per hectare private capital expenditure in only rural areas for two reasons. *Firstly,* the expenditure incurred under most heads of private capital expenditure in urban areas is quite negligible. *Secondly,* more than 70 percent of population still lives in rural areas. Out of the remaining population in urban areas, population investing in agriculture constitutes a very tiny proportion. Though we have interpolated the data about the private capital formation at the state level for both the states for the mid years of AIDIS, we refrain from following the same practice at the component wise expenditure. We are rather content with the comparison at the three points 1981-82, 1991-92 and 2002-03.

The table 4.1 gives a detail about the per hectare expenditure incurred in all the broad heads of private capital expenditure. Of all the heads, the difference between the two states is widest in the two heads- improvement /reclamation of land and

agrimachinery/transport. The large difference in the expenditure in the land reclamation can be attributed to the active and successful implementation of land reforms in the state of West Bengal.

Table 4.1: Per hectare private fixed capital expenditure in farm business (rural) in Assam and West Bengal.

Name of Items	1981-81		1991-92		2002-03	
	West Bengal	Assam	West Bengal	Assam	West Bengal	Assam
1) Improvement/ reclamation of land	21.67	15.28	88.78	1.47	45.52	8.11
2) Orchards & Plantation	4.21	6.81	20.65	11.51	6.50	1.80
3) Farm houses & constituent	39.30	34.18	37.17	50.00	31.21	27.03
4) Wells & other irrigation sources	7.92	5.36	24.78	2.94	1.30	7.21
5) Agrimachinery & transport	59.66	17.74	94.98	30.88	59.82	17.12
6) Others	7.08	9.33	26.84	14.71	10.40	10.81
Total	139.84	88.70	293.20	111.51	154.75	72.08

Source: All India Debt and Investment Survey, 1981-82, 1991-92 and 2002-03

The same can be said about the expenditure incurred in the machinery and transport. An effective implementation of land reforms has its concomitant effect in the form of increased expenditures in agrimachinery and transport. As land distribution under the land reform programme started vigorously, the expenditures on machinery increased due to increased number of land holdings. However, the sharp fall in expenditure on land reclamation and agrimachinery in the state of West Bengal in the last AIDIS as compared to the one in 1991-92 suggests that the land reform programme has either lost its steam or already exhausted the scope in the late 1990s. In comparison to its neighbouring state, the per hectare fixed capital expenditure in the improvement and reclamation of land in the state of Assam remained negligible in all three survey years. However, there is not much difference in the expenditure of other heads between the two states. The private expenditure of both the states have witnessed a similar pattern as almost all the broad heads of expenditure in both the states fell sharply in 2002-03 after equally sharp rise in

the 1991-92. Another notable trend that emerges from the above table is that the total per hectare private capital expenditure in agriculture in the state of West Bengal was almost double that of Assam in all three survey years.

Table 4.2: Percentage share of different heads of Private fixed capital expenditure in farm business (rural) in Assam and West Bengal

Name of Items	1981-81		1991-92		2002-03	
	West Bengal	Assam	West Bengal	Assam	West Bengal	Assam
1) Improvement/ reclamation of land	15.50	17.23	30.28	1.45	29.41	11.25
2) Orchards & Plantation	3.01	7.68	7.04	1.45	4.20	2.50
3) Farm houses & constituent	28.10	38.54	12.68	49.28	20.17	37.50
4) Wells & other irrigation sources	5.66	6.04	8.45	2.90	0.84	10.00
5) Agrimachinery & transport	42.67	20.00	32.40	30.43	38.65	23.75
6) Others	5.06	10.52	9.15	14.49	6.72	15.00

Source: All India Debt and Investment Survey, 1981-82, 1991-92 and 2002-03

The table 4.2 gives a better picture of the changing composition of the asset structure in the private account of capital formation in agriculture in both the states. As evident in the table, agrimachinery/transport followed by farm houses topped the list of preference in the private capital expenditure account of the farmers in the state of West Bengal in year 1981-82. However, the capital expenditure in the improvement/ reclamation of land has emerged as the priority area in the state in 1991-92, pushing farm houses &other constituent to the distant third position in the next AIDIS 1991-92. Though the share of capital expenditure in the farm houses construction has increased in the last decade and the same on land reclamation observed fall, the former continues to languish in the third position. As far as Assam is concerned, expenditure on the farm houses construction has remained the most preferred avenue throughout the period 1981-2003. Agrimachinery /transport retained the 2nd most preferred option in the farmers' portfolio in all three surveys in the state. Though the capital expenditure in improvement / reclamation of land accounted for a significant portion of the farmer's budget in the year 1981-82, it lost its position in the subsequent period. Along with 'Others' expenditure head, capital

expenditure on wells and other expenditure head is one of the least preferred area of expenditure in both the state throughout the period.

Table 4.3: Percentage change per decade in different heads of private capital expenditure in farm business in rural West Bengal in the period 1981-02

Name of Items	1981-91	1992-03
1)Improvement/reclamation of land	292.70	-47.41
2)Orchards & Plantation	370.43	-67.69
3)Farm houses & other constituent	-9.35	-13.85
4)Wells & other irrigation resources	200.00	-94.62
5) Agrimachinery/transport	52.59	-35.39
6)Other expenditure	263.53	-60.42
Total	109.67	-47.22

Source: All India Debt and Investment Survey, 1981-82, 1991-92 and 2002-03

The table 4.3 and 4.4 gives an idea about the percentage change of component wise capital expenditure in agriculture in the state of Assam and West Bengal respectively over the two decade period. One of the most disconcerting facts about the private capital formation in agriculture in the state of West Bengal is that all the broad heads of private capital expenditure have suffered fall in the 2002-03 over the previous survey year 1991-92 with wells and other irrigation resources being the worst effected sector. This is in stark contrast to the decade of 1991-92 which recorded increase in all other broad heads of expenditure with farm houses and other constituent being the only exception. The scenario is quite different in Assam as the heads like land improvement and irrigation have registered impressive growth rate in the last decade. However, as they were already very low to begin with, even substantial increase in the private capital expenditure appears insignificant in absolute terms.

Table 4.4: Percentage change of different heads of private capital expenditure in farm business in rural Assam for the period 1981-02.

Name of Items	1981-91	1992-03
1)Improvement/reclamation of land	-90.19	450.51
2)Orchards & Plantation	72.16	-84.37
3)Farm houses & other constituent	49.10	-46.03
4)Wells & other irrigation resources	-44.08	144.67
5) Agrimachinery/transport	77.48	-44.66
6)Other expenditure	60.67	-26.60
Total	25.71	-35.36

Source: All India Debt and Investment Survey, 1981-82, 1991-92 and 2002-03

However, the total private capital expenditure in agriculture experienced net decline in the decade of 1992-03 as compared to the previous decade in both the states.

4.2 A comparative study of public capital formation in agriculture

However, private investment forms only a part of capital formation in agriculture. Agriculture comes within the purview of the state government which also makes a considerable investment in the sector. As the data about public capital expenditure in different headings are available from the state budget and finance account/appropriation account, we will cover the entire period instead of looking at some particular points. At the same time, we prefer to look at the data in some block wise rather than looking at each and every single year. We have made the following blocks 1981-86, 1987-92, 1992-97 and 1997-02 and calculated annual capital expenditure for each period. Though there is no strong reason for choosing the particular blocks, we have arranged it in a manner that it coincides with 5 year planning of the union government. The entire budget heads are divided into four major sections, namely- Capital Accounts of agriculture & Allied activities, Irrigation & flood control projects, land reforms and also capital account of areas relevant for agriculture. However, for the later period, i.e., 1987 till 2002, we have added another head namely- capital account of Special Area Programme. This broad head contains within it many minor heads, but they are added up into one group or the other to facilitate comparison between broad heads. Capital account of agriculture & allied

activities include capital output on crop husbandry, animal husbandry, dairy development, fisheries, food storage, warehousing and co-operation and also rural development. Similarly, capital account of Special area programme is a compilation of three heads namely, capital account of Hill areas, Northeastern Areas, Other Special area programme. Capital account of Irrigation & flood control includes minor heads like Major & Medium Irrigation, Minor Irrigation, Command Area Development and flood control project. Another head considered for the analysis of public capital formation in agriculture is investment in areas relevant for agriculture that includes investment on rural roads, rural electrification and investment in fertilizer industries. Since land reform is believed to act as a catalyst in the impressive performance of West Bengal agriculture over the last two decades, we have treated it as another separate head of capital expenditure in agriculture. Many economists believed that amongst many factors, land tenure system prevalent in an area has considerable influence on the volume and pattern of capital formation in agriculture[1].

Very much like the capital formation in agriculture at the national level, the scenario of capital formation in agriculture at the state level is same with the wells and irrigation accounting for a major portion of public capital expenditure in agriculture. During the period 1981-87, irrigation and flood control project account for major portion of government expenditure in agriculture in both the states as shown in the table 4.5 and 4.6. However, the government expenditure in land reforms in the state of West Bengal was much higher than Assam as the land reform account for 2.65 percent of total budget expenditure in Assam in stark contrast to 21.08 percent in West Bengal. The capital expenditure in the areas relevant for agriculture, which we term as 'expenditure for agriculture' is an important head of expenditure in both the states even in the early 1980s. However, the capital expenditure on flood control and irrigation has gradually declined in importance in Assam over the period.

Table 4.5: Percentage share of different heads of public capital expenditure

[1] D Jha and S.D.Salunke: Land Tenure System and Capital Formation in Agriculture, *Indian Journal of Agricultural Economic*, vol.24,No1,1969,p130

in Agriculture in Assam for the period 1981-02

Name of Heads	1981-87	1987-92	1992-97	1997-02
1)Agriculture & Allied Activities	9.36	1.60	5.22	7.58
2)Special Area Programme	---	5.02	17.35	20.27
3) Irrigation & Flood Control Measures	68.19	81.75	34.70	22.49
4)Expenditure relevant for agriculture	19.81	10.60	34.48	43.73
5)Land reforms	2.65	1.02	8.24	5.93

Source: Budget and Finance Accounts of Assam for the years 1981 to 2002

The expenditure on irrigation and flood control, which was over 80 percent in the period 1987-92 later fell to 22.49 percent in the period 1997-02 in Assam. On the other hand, expenditure on areas relevant for agriculture has emerged as the most important head of public capital expenditure in Assam in the period 1997-02. Another head of capital expenditure that rose significantly in Assam's agriculture in the later period is the capital account of Special Area Programme whose share rose from 5.02 in 1987-92 to 20.27 in 1997-02. This seems obvious, given the fact that the state receives funds from Union government as part of Special North East Area Programme package.

Table 4.6: Percentage share of different heads of public capital expenditure in agriculture in West Bengal for the period 1981-02

Name of Heads	1981-87	1987-92	1992-97	1997-02
1)Agriculture & Allied Activities	8.44	21.57	16.52	5.89
2)Special Area Programme	---	0.54	13.21	5.49
3) Irrigation & Flood Control Measures	56.31	38.94	29.73	44.31
4)Expenditure relevant for agriculture	14.17	17.59	27.96	42.08
5)Land reforms	21.08	21.35	12.58	2.22

Source: Budget and Finance Accounts of West Bengal for the years 1981 to 2002

Very much like Assam, expenditure in areas relevant for agriculture has come to play a significant part in West Bengal's agriculture as its share rose from 14.17 in 1981-87 to 42.08 in 1997-02. The public expenditure on land reform was always

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higher in West Bengal due to its committed effort in implementing land reform. However, governments' active support in the land reform programme has tapered off in the late 1990s as its share has declined from 21.35 in 1986-87 to 12.58 in 1992-97 and then fallen further to 2.22 in 1997-02.

A comparative study of per hectare public capital expenditure in different broad heads will give a better picture of the level of public expenditure in agriculture in the two states.

Table 4.7: Per hectare public capital expenditure in agriculture in Assam for the period 1981-02

Name of Heads	1981-87	1987-92	1992-97	1997-02
1)Agriculture & Allied Activities	29.44	15.78	14.34	44.94
2)Special Area Programme	---	49.46	47.65	120.16
3) Irrigation & Flood Control Measures	214.56	805.26	95.30	133.33
4)Expenditure relevant for agriculture	62.33	104.40	94.70	259.31
5)Land reforms	8.34	10.07	22.62	35.81
Total	314.67	984.97	274.61	593.55

Source: Budget and Finance Accounts of Assam for the years1981 to 2002

A close examination in the per hectare public capital expenditure of different heads reflect a significant change of pattern of government expenditure in the last two decades. The annual capital account expenditure of Irrigation & flood control measures, which was most dominant component with Rs 214.56 per hectare in 1981-87, increased to Rs 805.26 in the 1987-92, but later fell to Rs 133.33 in 1997-02. On the other hand, capital expenditure relevant for agriculture has emerged as most important area in the last decade as per hectare expenditure of Rs259.31 is much higher than the other heads of public capital expenditure. The heads of expenditure like Agriculture & Allied Activities and land reform have increased steadily over the years.

In case of West Bengal, the heads like Irrigation and areas relevant for agriculture have recently emerged as the strong areas for government investment with both

recording over Rs300 per hectare expenditure while other heads of expenditure have even failed to record over Rs 50 per hectare. The head of capital expenditure on land reform is conspicuous by its sharp decline in terms of per hectare expenditure from Rs 33.48 in the period 1981-87 to Rs 17.76 in the period 1997-02, which is quite significant, given the commitment of the Lefts' government in implementation of land reforms.

Table 4.8: Per hectare public capital expenditure in Agriculture in West Bengal for the period 1981-02

Name of Heads	1981-87	1987-92	1992-97	1997-02
1)Agriculture & Allied Activities	13.39	40.47	31.45	47.08
2)Special Area Programme	---	1.01	25.14	43.90
3)Irrigation & flood control measures	89.33	73.05	56.59	354.02
4)Expenditure relevant for agriculture	22.48	33.00	53.21	336.26
5)Land reforms	33.48	40.04	23.95	17.76
Total	158.68	187.57	190.34	799.02

Source: Budget and Finance Accounts of West Bengal for the years1981 to 2002

However, this may be partly attributed to the already exhausted scope of land reform programme. The steep rise in the expenditure of Irrigation & flood control in the state of West Bengal is in stark contrast to the sharp fall in the expenditure of the same head in the neighboring state. Even a cursory look at the budgets of both the states throws a common trend in both the state budgets- while expenditure in areas like agriculture and allied activities have slowed down, the expenditures on areas indirectly related to agriculture i.e., 'expenditure for agriculture' have increased significantly over the same period.

The overall impression that most of the national and state level studies portray is that there has been complete break from the pre-planned era when exogenous factors like increases in labor supply seem to dominate the performance of the agricultural sector. The second phenomenon that needs to be emphasized is that in the planned era, the public sector investment in agriculture has emerged as important factor in stark contrast to the period prior to planning when capital formation in the private sector

dominated with public investment being restricted mostly to irrigation of protective type[2]. Agriculture at that time was being run more or less on traditional patterns and irrespective of the importance attached to it under the Grow More Food Campaign started sometime in 1942, there was hardly any improvement in its development.[3] As planning gathered momentum and investment in public sector started gearing up, it provided welcome spur to investment activity in private sector too and both together resulted in an impressive performance of the country's agriculture sector in the decades. However, the public sector investment in agriculture has undergone gradual transformation in the last two decades as it is no longer all about irrigation and public canal. Infact, over the period, public investment in agriculture has diversified and expanded into areas relevant for agriculture that include rural transport, rural electrification and fertilizer industries etc. Moreover, the role of public capital formation in agriculture has changed as the private capital expenditure has emerged as a crucial player in the last two decades.

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[2] Tara Shukla: Capital Formation in Indian Agriculture, *Indian Journal of Agricultural Economics,* Vol. 20, No.2, 1965.p.

[3] P.C.Bansil: Role of Irrigation and Fertilizers in Capital Formation, *Indian Journal of Agricultural Economics,* vol.24,No1,1969 p.19

Conclusion

Indian agricultural has come a long way as it has made a successful transition from an economy that once made heavy imports to meet its demand for food to one that is not only self reliant on food , but has also started exporting surplus food. Among the factors that contributed to this spectacular performance of our agricultural sector, government played a crucial role through its intervention in the form of the price policy and investment policy. Apart from the subsidized input prices, the government support through price policy includes MSP, Procurement price, administered prices of farm products. However, passive support of the government to agriculture through its price policy on food grains is outside the scope of our research proposal. We have preferred to focus on the capital expenditure of government in agriculture for a period that spreads over four decades, starting with 1960-61.

Though subsidies on inputs, mainly fertilizers, electricity and water constitute part of the government expenditure in agriculture, our concern is mainly on the capital expenditure in agriculture, which largely consists of its expenditure in the construction of medium and major irrigation projects. Our studies on the estimate of capital expenditure in agriculture drive home the point that a comprehensive measure of capital expenditure in agriculture includes expenditure on rural electrification, rural roads and investment in fertilizer industries, financial institutions that give credit to agriculture, rural development and other allied activities. A close examination of the trend of such broad measure of public capital expenditure in agriculture in the last four decades reflects that government expenditure in agriculture has changed in favour of areas relevant for agriculture. Expenditures on areas like irrigation, which accounted for major portion of government expenditure earlier, have witnessed a gradual decline over the same period. But, CSO data on public capital formation in agriculture has failed to highlight these changes in the capital expenditure as expenditure on irrigation

account for more than 80 percent of total capital expenditure in agriculture reported in it. To arrive at a comprehensive measure of capital formation in agriculture, we have used budget documents and finance accounts to re-estimate public capital formation. Our broad measure of capital formation in agriculture also dispelled the notion that increase in the other heads of capital expenditure has more than offset the fall in the government expenditure in irrigation in last two decades. Infact, expenditure in other heads have also witnessed equally, if not more, sharp fall in expenditure in that period. However, this is not to say that the trend of public capital expenditure in agriculture under broad measure is identical with that under CSO measure.

We later proceeded to examine the relation between the public and private capital formation in agriculture at all India level in the light of the observation by some quarters that the complementary relation between the public and private capital formation in agriculture has weakened over time. The co integration test and correlation and regression analysis later confirmed that the complementary relation between the types of capital formation in agriculture has weakened in the last two decades. However, realizing the limitations of our statistical exercise, we have refrained from rushing into judgments that the complementary relation between them has completely vanished or replaced by one of substitution. Apart from limitations on our statistical technique, we have also limitations on data even after inclusion of the 'expenditures for agriculture' under broad heads of capital expenditure. In the estimation of public capital expenditure, we did not include the external assistance that government received from foreign countries and UN under various projects from time to time.

The weak evidences in support of the complementary relation between the public and private capital formation in agriculture at the national level does not guarantee that the same will be valid even at the state level. India is a country with 28 states and 10 Union territories . In a country of such continental size, it is quite natural that states are located in different agro-climatic zones. On the one

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hand, we have states like Punjab, Haryana and Western U.P. which are surplus food producers, on the other hand, states in the southern and eastern part of India are not self sufficient in food production. After the examination of the relation between the public and private capital formation in agriculture at the all India level, we have tried to replicate the similar exercise at the state level. However, our state level study is limited to two states, Assam and West Bengal for reasons already stated in the introduction. A close look at the trend of capital expenditure on both public and private account clearly shows that private capital expenditure in agriculture have failed to gather kind of momentum, we have witnessed at the national level and public capital expenditure have continued to call the shots in both the states. Co-integration and regression analysis and later correlation analysis lend importance to the view that the weak complementary relation between the public and private capital formation in agriculture is no longer just a national event. The change in the relation between the types of investment is all pervasive and may be valid even at the state level. However, the same findings at the national level and state level may have different implications. In stark contrast to all India level, both Assam and West Bengal have experienced a fall in the private capital formation in agriculture. Very much like our national level study, our research at the state level is not free from limitations on both data and methodology. Infact, the problems of data limitations in the state level is even more pronounced than at the national level. Though we can get the information about the private capital expenditure in agriculture at the state level from AIDIS, it does not include the private corporate investment in its estimation of capital expenditure in agriculture. Moreover, AIDIS furnish information on the private capital formation in agriculture once in a decade. To the extent we have smoothed out fluctuations in the private capital expenditure in our interpolation of data for the interval period, it has its effect on our result. Apart from that, we have failed to incorporate financial assistances that a state government may receive from the central government for centrally and some jointly funded projects. Under such circumstances, it may be inappropriate to rush on any comment regarding the

relation between public capital formation and private capital formation in agriculture.

After verifying the hypothesis of such relation between the capital expenditure in agriculture on both public and private accounts, we have made a comparative study of the asset composition of expenditures on both accounts in the states of Assam and West Bengal. One clear trend that emerges from such comparison is that expenditure in areas 'for agriculture' has emerged as a favourite avenue in both the states. On the other hand, the expenditure in areas like land reforms has started losing its relevance after 1990s even in West Bengal, a state known for its commitment to implement land reform programme.

A common trend that emerges from our examination of the capital expenditure on both public and private account at the all India level and the state level is that capital expenditure on the public account has received a setback in the last two decades. Though we have so far tried to provide a mechanical explanation to the declining trend of the public capital expenditure in Indian agriculture, it has a behavioural explanation in terms of political economy. The behavioral explanation of such trend in the capital expenditure lies in the political economy of the government's agricultural policies that crystallized towards the closing years of 1970s, with the formation of the Janata Government[1]. This new politics of agricultural policies was a product of the green revolution that had run a successful course over 10 years preceding the closing years of the decade of 1970s.The most obvious outcome of the successful green revolution was quite apparent. It made our nation self-sufficient in food and ensured food security. However, another consequence of the green revolution that often goes unnoticed is the emergence of the farmers as a politically conscious, interest seeking groups. The farmers gradually started reasserting themselves as a 'class for itself' vis-à-vis the government policies after the success of green revolution. During that period, a number of politically powerful organizations and unions of the farmers emerged

in the country to represent the large, 'modern' and so-called 'progressive farmers' who had been the torch-bearers of the green revolution. These organizations contained the contradictions and conflicts of interest within the farming community two ways. *Firstly,* as every farmer has to be involved in the market of food grain either as seller or buyer, all the farmers- large, medium, small or marginal farmers were mobilized on the price support front (on output and input).*Secondly,* these organizations successfully demanded and approved a major programme of rural development like IRDP that mainly benefited the small, marginal farmers and the landless labourers. The organizations and unions of farmers represented the interest of the farmers and determined the nature and content of agricultural policies, the pattern and size of public expenditure on agriculture.

There was nothing wrong with such process of policy making in agriculture as the strong presence of such organizations were justified on the ground of national food self-sufficiency and social equity. Infact, there was no political parties which could afford to ignore the farmers' lobby at that time. However, the nature of the struggle spearheaded by these unions changed towards the late 1970s after the green revolution lost its steam.

At any time, all economic policies are formulated and implemented to serve two interests: social interest and private group or class interest. When social interest guides such policy making, the state exhibits its autonomous character. However, when private group or class interest predominates in the determination of policies, the state exhibits its subservient, instrumental character. The agricultural policies that launched the green revolution were the actions of the autonomous state. However, the state virtually lost its autonomy with the exhaustion of the green revolution towards the late 1970s, a period that was marked by the formation of the first non-congress government at the centre.

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[1]Misra and Chand, op cit, no2, p.A-74.

No discussion on the capital formation in agriculture is complete without any reference to subsidies. There can be little doubt regarding the overall direction subsidies on power, irrigation and fertilizer are moving towards. Over the past two decades, these subsidies have gradually swollen from a mere Rs11.4 billion in 1981-82 to current levels; at 1981-82 prices there has been an increase of more than 9 times over these two decades[2]. It is essential to recognize that growing subsidies have been accommodated by squeezing out investments. The burgeoning subsidies compete for scare resources and impinge upon the government ability to invest in key areas. Increasing subsidies, in short, crowd out public investment. Vaidyanathan points out that unrecovered costs on the three main inputs- irrigation, power and fertilizer are 50 percent higher than the public sector plan outlay on agriculture, rural development and irrigation[3].

Now that we have a brief idea about the trend of the subsidies in Indian agriculture and its implication on public investment, we can go back to the political economy that explains the simultaneous rise in public expenditure on agriculture and irrigation, decline in public capital formation and rise in private capital formation since 1980s. It has been in the interest of the farmer's group to first maximize current account expenditure which directly accrues as subsidies and then out of the balance available for capital formation, maximize the share to support private capital formation in the form of soft term loans and subsidy, the residual only being available for public capital formation.[4] It has been since 1980s that the powerful farmers' lobby started influencing the determination of allocation of public funds committed for agriculture. When it comes to a choice between expenditure on current and capital accounts, the farming group interest tried to influence the allocation of public funds in favour of the former. And, within the capital account, they preferred the private sector capital expenditure over the public sector capital expenditure. Their preference for private capital

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[2] Ashok Gulati and Sudha Narayanan (2003): The Subsidy Syndrome in Indian Agriculture, p.186.
[3] ibid,p.202
[4] Misra and Chand,op cit, no.3,p.A-75.

asset over public capital asset is quite obvious as private capital asset is under direct control and command of individual farmer. Moreover, its service is certain, and can be deployed as and when required. Under such circumstances, it is not surprising to see that the rapid increase in the share of the current account expenditure to meet their demand for production subsidies plus their priority concern to finance private sector capital formation have left very little room for the state to enhance public sector capital formation growth. We can thus trace the decline in the real public capital expenditure in agriculture since early 1980s to the politics of the state's agricultural policies, which took root during the late 1970s.

Apart from that, 1980s saw the emergence of few other external factors that restricted whatever autonomous choice the state was left for raising the level of public capital expenditure. *Firstly,* the per hectare cost of the major and medium irrigation projects started rising very rapidly as compared to the minor irrigation project during that period. *Secondly,* the period of 1980s was marked by the forceful rise of environmentalist movement, domestic as well as foreign against these systems of major and medium irrigation. Many environmentalists have succeeded in limiting bilateral and multilateral aid and putting conditions on such release of funds that includes the desired change in the design of the systems. One such burning example is the Narmada system. *Thirdly,* the federal character of the Indian state itself became severe constraint on public capital formation in irrigation systems. With the emergence of the regional parties during 1980s, the endemic problem of inter state disputes about water sharing became more severe.

However, rising subsidies bill alone does not explain the over all declining trend of public capital expenditure in agriculture we have witnessed in the last two decades. It may be partly attributed to the general decline in the government expenditure under fiscal compression measure introduced since 1991. The fiscal austerity drive introduced by the government to meet the IMF conditionalities has its adverse effect on soft areas like social sector, capital expenditure in agriculture etc.

In the light of our discussion of public capital expenditure in agriculture, we can take a look at the nature of agricultural growth. It is argued that the pattern of growth in agriculture since 1990s is under structural transformation. 'While growth in agriculture during 1970s and 1980s were largely driven by technology, incentives by the government in terms of support/ procurement prices and heavy investment in canal irrigation and power supplies, the agricultural growth in the 1990s seems to be demand and market driven. Incentives in terms of improvement in TOT and private sector investment in minor irrigation and agricultural machinery appear to be new drivers of growth'.[5] Despite the changes in the nature of agricultural growth, no one can dispute the fact that the objective of accelerating agricultural growth to around 4 per cent per year requires, *inter alia*, a significant increase in investment in agriculture and related sector. Such investment would obviously include investment in major, medium and minor irrigation, land improvement, water management and conservation system and farm machinery. We also need to ensure higher investment in rural electrification, improvement of rural roads and other rural economic infrastructure, and investment in agricultural research. Some of the investment can take place in the private sector, but a great deal has to be in the public sector. Given the relevance of the public investment in agriculture, higher level of such investment must be achieved within the macro-economic constraint of fiscal prudence.[6] There is number of ways that a state can raise revenues to finance its investment in agriculture. *Firstly,* the state can withdraw resources from public sector investments in many areas that can now be left to the private sector. *Secondly,* state government can disinvestment from earlier investments and use the proceeds of such disinvestment for investment in agriculture and related sectors.

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[5] Gulati and Bathla, op cit, no1,p.1707.

[6] Ahluwalia (1996) suggests that such investment in agriculture have to be financed either by reducing other unproductive public investment in non essential areas from which the State should withdraw, or by increased public saving which would enable higher level of public without adding to the fiscal deficit.

However, major chunk of the resources should be raised through redirection of resources currently being absorbed by subsidies to agriculture. Though there is definitely a role for input subsidies in agriculture, these subsidies, if carried beyond a point, distort relative input prices, leading to considerable inefficiencies in input use[7]. Moreover, this measure of raising revenue has an added appeal. While India's input subsidies in its prevalent form constitute Amber measure and are hence subject to limits under the URAA, investment are permissible under the Green Box and have no such restrictions[8]. Investment may in fact be the key to mitigating the adverse impact of input subsidy reform.

Finally, our research on capital formation in agriculture is far from being comprehensive. We have left out a crucial aspect of capital formation in agriculture, i.e, the efficiency of the capital use. If the efficiency of the use of capital, particularly in the sphere of public sector, has really improved in the last two decades, it may negate the adverse effect of the fall in the public capital expenditure in agriculture. Despite such limitations of our research, we finally hope to help future researchers in carrying forward the debate on capital formation in Indian agriculture.

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[7]Ibid,p.416
[8] Ashok Gulati and Sudha Narayan, op cit, no.1,p.204

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