CAPITAL FORMATION, AGRICULTURE GROWTH, AND POVERTY: CONCEPTUAL AND EMPIRICAL CONSTRUCTS

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1. **The Theme**:

The number of people without enough food to eat on a regular basis remains stubbornly high, reaching one billion at the global level. Poverty, the inability to attain a 'minimum' level of wellbeing, is the most fundamental economic and social problem facing humanity. The U.N endorsement of Millennium Development goal of halving the number of chronically undernourished people by 2015 is far from achievement in many countries, including India.

One important way to examine the issue of global poverty and hunger is to identify the spatial and social distribution of poverty to facilitate operationalisation of focus on development policies and strategies (Bisaliah 2009.b). Regarding spatial distribution of poverty at global level, South Asia and Sub-Saharan Africa are the hunger hot spots. Two thirds of the World's poor live in Asia, especially in South Asia. A recent study by Econommic and Social Commission for Asia and Pacific (2008) has concluded that over 600 million of the words poor still live in Asia, 97 million children remain under nourished, and four million children die before reaching the age of five. Further poverty is dominantly a rural phenomenon in food insecured regions. It is estimated that 70% of the people of the food in-secured regions are in rural areas. With respect to social distribution of hungry people, about 50% are small land holders and two-tenths are landless labourers. In fact, women represent the distressing manifestations of hunger and gender inequality facing excess mortality and are called 'missing women'. It is true that the immediate concern is to address the food security problem of South Asia and Sub-Saharan Africa, but the global attention will have to be devoted to livelihood security (of which food security is only one subset) of the poor and the deprived (For components of livelihood security, see Bisaliah 2009.b)

The issue of poverty and food security could well be placed in some development experiences and some empirically proved premises. First, high GDP growth rate is necessary condition of food security (let alone livelihood security) of the poor people. But the sufficient condition is to search for a pattern of growth that could make a dent on poverty and hunger. The development experience of many countries (Details later) suggests that the choice of pattern of growth falls on rural farm and non-farm sector growth. That explains why the difference between GDP maximizing growth and poverty minimizing growth (called pro-poor growth) should be kept in view, while designing development policies and programmes. Second, another development experience is that service-led high GDP growth rate in India and decelerated growth in agriculture sector have led to slowdown in poverty reduction. Third, crop and non-crop diversification towards sunrise sectors such as horticulture, livestock, fishery and other high value enterprises in rural areas could very well contribute for poverty reduction and livelihood security. Fourth, countries that have succeeded in reducing poverty are characterized by more rapid growth, more importantly rapid growth of rural sector, lower population growth and higher ranking in Human Development Index. Fifth, the development experiences have substantiated the evidence that agricultural capital stock, and productivity of labour engaged in agriculture, and prevalence of hunger in developing countries are highly related. Keeping all these in view, the present study, in broad terms, is an attempt to examine the cross country experiences as related to capital formation, growth / agriculture growth and poverty in the frame of both theoretical and empirical constructs. The specific theme of the study is detailed as below:

- Examine the 'role' of capital in growth theoretic models and the role of capital vis-à-vis other determinants of growth in cross country growth accounting empirical studies. What do the analysis of convergence / divergence between Total Factor Productivity (TFP), labour productivity and capital intensity suggest to developing countries?

- Discuss the variations in cross country agriculture productivity and the productivity growth accounting factors.

- How is the nexus between growth and poverty, and why is agriculture to be treated a pro-poor growth sector in developing countries in the perspective of growth mediated versus growth-plus-intervention approaches to poverty reduction?

- What are the evidences on the relationship between Agriculture Capital Stock, productivity of labour engaged in agriculture and prevalence of hunger in developing countries?

- Examine the analytical constructs and empirical evidences related to capital formation, agriculture growth and poverty in India, focusing on data sets on agriculture capital stock, investment behavior of government and farm households, trends in the levels and the composition of capital formation, complementarity between public and private investment, and the importance of capital formation in agriculture growth and poverty reduction.

- Based on the analysis of cross country experiences and of India as a case study regarding the nexus between capital formation, agriculture growth and poverty, derive policy-programme interventions for developing countries.

2. **Capital In Growth-Theoretic Models and Growth Regressions**:

A search for sources of Growth in both theoretical and empirical models and the role of capital as one of the drivers of growth would form a broader perspective for studying the nexus between capital formation and agriculture growth. In this section, the broadening and deepening of the concept of capital, the role of capital in "three" broad waves of growth theory and cross country growth regression exercises performed to get at growth accounting are examined.

2.1. **Broadening and Deepening of the concept of capital**

The concept and measurement of capital has been an important area of both theoretical and empirical debate among economists (Robbinson 1953-54 and 1956; Griliches 1966; Harcourt 1972 and Harcourt et.al 1973) One of the important lines of arguments Ranson (1987) has been the advancement of the institutional theory of capital, wherein evolution

of the concept of capital has been traced. Ranson (1987) places emphasis on institutionalist definition of capital; at the core of institutional theory of production is technology (technology generation, transfer and utilization as subsystems), specifying a complex of materials, skills and equipment. Thus technology serves the function of capital. Further, technology is disseminated and improved largely through education and research institutions, while it is applied through economic institutions. More efficient institutions permit increasing the rate of output with the prevailing technology. Hence the theory locates creative potency not in capital accumulation as such, but in workmanlike operations of education and research institutions as well as economic institutions. The message for developing countries is quite clear; capital formation is a necessary condition for supporting growth, but the sufficient conditions assume the form of institutions to raise production possibilities by diffusing skills necessary to improve technology, apply or borrow.

2.1.1. **Capital in the Matrix of Deep Drivers of Growth**:

One of the ways to examine the role of capital in growth is to place it in the matrix of deep drivers of growth. The systematic search for the deep drivers of economic growth goes back at least to Solow (1956, 1957), and numerous factors have been suggested and studied as engines of growth since the 1980s, thanks to the research works of Romer (1986, 1987, 1989) Lucas (1988 and 2002) and others. In the context of the present section, a brief survey of some engines of growth (Hughes et.al 2008) and the relevance of different types of capital in the matrix of deep drivers of growth is in order. Human Capital (Sehultz 1961; Becker 1964; Lucas 1988), as well as learning by doing (Arrow 1962), knowledge capital generated through investment in R & D, (Romer, 1990), Social capital as an umbrella term for variety of concepts such as trust, social networks, honesty and civic engagements and so on (Hall et.al1999 Kumar et.al 2006), institutional capital (governance) and structures, physical capital (equipment), infrastructure capital (David 1993; World Bank 1994), and natural resource capital (physical and biological environment) could be considered as deep drivers of economic growth. The U.N. Millennium project (2005) recognizes physical capital, social capital, human capital, infrastructure, knowledge capital, natural capital

and public institutional capital as deep drivers of growth, among others. However Lucas (2002) recognizes that human capital is a very broad concept and therefore difficult to measure.

In brief economic growth is engineered mainly by three immediate drivers viz labour, capital (in the broad sense) and Multifactor Productivity or Total Factor Productivity (MFP / TFP, detailslater). TFP is residual that captures everything that is not measurable like physical and human input (Details on TFP later). Further the drivers of TFP are human capital, social capital and governance, infrastructure capital, natural capital and knowledge capital and so on.

2.2. **Capital in Growth / Development Theory**.

Three major streams of advancement in growth / development theory and the role of capital in the growth / development process could be identified (Stern, 1989; Solow 1994; Temple, 1999) The major focus of these advancement is to answer the question what drives economic growth, and where does capital stand in growth generation and sustenance.

2.2.1. **The classical Growth Theory**:

In Classical and the Keynesian theory of growth (as represented by Harrod-Domar Model), the emphasis is on role of capital accumulation, and the embodiment of the various forms of technical progress associated with. The Harrod-Domar growth analysis (Domar 1947; Harrod, 1948) leads to savings and capital-output ratios as determinants of growth. In this analysis, growth is expressed as the product of ratio of investment to GDP and the productivity of investment. This implies slow growth is the product of a low investment ratio/low productivity of capital, perhaps one of the proximate causes of low growth in developing countries, either overall or sectoral (like agriculture). In early growth / Development models (Lewis, 1954; 1955; 1958), structural change and capital accumulation (including knowledge and skill) are treated as the key aspects of development in less developed countries. Further, development economists like Rostow (1960) Lewis (1955) Cairn Cross (1966), Meir (1984) and Johnston (1969) have considered investment as the most

important single factor in the growth process. For example Johnston (1969) singles out capital accumulation as the distinguishing characteristics of development, and describes structural transformation of economies as a generalized process of capital formation. The condition of being 'developed' consists of having accumulated, and having established efficient social and economic mechanisms for maintaining and increasing large stock of capital per head in the various forms. Similarly the condition of being under developed is characterized by the possession of relatively small stock of various kinds of capital. In fact, the basic factor sustaining the high rate of growth in Japanese economy over the pre and post war period was a constantly maintained capital Formation (Koich undated). It is concluded (Gill 1976) that capital formation and incremental capital output ratio (ICOR) would account for variations in GDP growth rate across countries.

2.2.2. **The Neo-classical Theory of Growth**:

The growth theory pioneered by Solow (1956; 1957) and Swan (1956) disaggregates the sources of growth into contribution of labour, capital, technical progress and any other variable included in the growth accounting exercise. According to this theory the thrust for economic growth had to come outside the system, mainly from technological progress which is obviously treated as exogenous. But the fundamental question of why labour supply (both quantity and quality) capital accumulation and technical progress grow at different rates in different countries still stays with us. Further, the neo-classical growth theory led by Solow (1954, 1994) predicted convergence of per capital income across countries. But the evidences on sub-Shararan Africa, Latin America and some parts of Asia point towards divergent growth rates across countries, suggesting growth divergence instead of convergence.

2.2.3. **The New Growth Theory**:

The third stream of growth theory called New Growth Theory (NGT) or Exogeneous Growth Theory was pioneered by Romer (1990, 1986, 1987, 1989, 1994), followed by Rivera et.al (1990), Grossman et.al (1991), Aghion et.al (1992), Strokey (1991),

Young (1991, 1993), Pack (1994), Lucas (2002) and many others. Irrespective of refinements and elaborations of NGT, some of the major tenets are examined.

First, NGT is one of the major attempts to answer the question why do growth rates differ greatly across countries during the same period of time. In the neo-classical theory of growth, growth is exogenous, beyond the control of economic agents. But in NGT growth is endogenous, an important departure from the neo-classical theory. Growth arises from intentional action of economic agents and Government.

Second, the NGT believes that increasing returns to scale is made possible by sustained increase in capital (both human and physical). This would create a permanent increase in the growth rate of the economy.

Third, in the NGT, an important role is given to human capital. An increase in the rate of accumulation of human capital-stock of useful knowledge as an engine of growth-enhances the productivity of both human labour and physical capital (Lucas 1998, 1990, Barrow 1989). Human capital would help in preventing in physical capital from diminishing returns. For example the fast growth of the economy (improvement in productivity of both agriculture and industry), in Republic of Korea is attributed to human capital, coupled with other forms of capital accumulation (Young 1995, Nelson et.al 1999). In fact it is argued that differences in the productivity of nations are due to differences in the skill level and ability to handle technology by workers across countries. Solow (1994) while commenting on NGT observes that treating learning by doing as one mode of productivity increase (Young 1993) is in order.

Fourth, the NGT lays emphasis on the 'idea gap' between the developed and developing countries (Majumdar, 2005), which has made the former to grow at a higher rate than the later. The NGT is suggestive of the inference that globalization would give rise to capital and technology inflows to developing countries so as to bridge the 'idea gap'. In fact, innovation in technology is an important explanatory factor to the growth rate in ay economy (Grossman et.al 1991). In other words, it views economic growth from the point of view of creative destruction (an elaboration

of this concept in Schumpeter, 1934), and introduction of new technology would help countries to climb up in the 'quality ladder' of technology which in turn would lead to higher growth rate of the economy (see Majumdar 2005 for the relationship or lacks of it between capital inflows and economic growth in India).

The implications of NGT are profound, with messages for designing policies to increase growth. For example, the externalities associated with human capital suggest that any underinvestment in education and other forms of human capital should be addressed by policy initiatives such as subsidies, because such investment would increase the rate of growth. The NGT also opens up the avenues for getting into the black box of productivity and understanding its origin. The main message of NGT is that the role of various forms of capital among others, is quite crucial as engines of growth.

2.2.4. **Growth Accounting Through Growth Regressions**:

Even though there are many growth accounting empirical exercises, only some are examined in this study to answer questions. First, what factors would account for variations in growth performance of different Countries? What is the relative importance of physical and human capital and TFP in growth performance across Countries? Why are the cross Country differences in TFP? What factors would determine TFP growth? Why output per worker varies enormously across Countries? Could there be growth convergences?

In the growth accounting exercise performed by Senhadji (2000) for 88 Countries with data for over 30 years (1960-1994), the major inference is that capital accumulation cannot sustain long-run growth, while TFP can. Then, what are the determinants of TFP growth? Why the differences in TFP? TFP is a function of human capital, physical and natural capital, social capital, governance equality and policies, knowledge development and diffusion (R&D) and economic integration with outside world (Hughes et.al 2008).

Temple (1999) in his study of New Growth Evidences concludes that the key reason for cross country variation in growth is macroeconomic management. The three proximate causes of growth identified are physical capital, human capital and R&D. The wider influences of growth are population growth, openness to trade, financial intermediation (banking system and stock exchange), Government spending on infrastructure, social and political arrangements and soon. Kanbur (2004), in his study Development of Development Thinking, would provide insights into the role of economic, social and political, factors in influencing growth performance in different countries (See Stern, 1989 for some of the 'Grand Issues' of development).

The issue of variations in output per worker across countries is yet another area of growth accounting exercise (Hall et.al 1999). In 1988, output per worker in the U.S was more than 35 times higher than output per worker in Niger. In Just over ten days the average worker in U.S produced as much as an average worker in Niger produced in an entire year. According to the analysis (Mankiew et.al 1992; Dougherty et.al 1996), based on aggregate production function, growth differences among countries could be attributed to differences in human capital, physical capital and productivity. It is true that countries produce high level of output per worker, because they achieve higher rates of investment in physical and human capital, and because they use these inputs with a high level of productivity. Why would some countries achieve these, and others cannot? Hall et.al (1999) has argued that success on each of these fronts is driven by the institutions and policies (called social infrastructure) that make-up the economic environment within which the economic agents make investments, create and transfer ideas, and produce goods and services. The results of this study indicate that differences in social infrastructure account for much of the differences in long growth performance throughout the World as measured by output per worker. The index of social infrastructure and output per worker varies directly. For example, Switzerland, U.S and Canada represent the countries with highest level of social infrastructure and highest level of output per worker, whereas Zaire, Haite and Bangladesh represent lowest level of social infrastructure and lowest level of output per worker.

Recent empirical evidences suggest that technical progress, human capital accumulation, increasing returns to R & D, and Government policies might have better explanatory power in determining variations in income across countries (Barrow et.al 1995). In fact, this is one of the central themes of NGT.

Yet another issue is how growth convergence could occur in some countries? Wolff (1991) in his study on growth catch up among the 'group seven' developed countries (U.S, U.K, Japan, Germany, Italy, France and Canada) between 1870 and 1979 comes out with the following inferences:

- Between 1950 and 1979 there was a strong convergence in TFP, labour productivity, and capital intensity among the group of seven.
- Positive correlation of 0.79 was found between the rate of TFP growth and that of capital: Labour ratio. This supports the existence of positive interaction between technological advance and capital accumulation and TFP catch-up.
- It follows that sustained capital accumulation is necessary to put new inventions into practice and to effect their wide spread employment. This association is referred to as the 'embodiment effect', since at lease some technological innovation is embodied in capital.
- It is also consistent with the 'Vintage effect' which states that new capital is more productive than old capital per (constant) dollar of expenditure.
- The investment growth may lead to growth in demand and thereby to the maintenance of favourable climate for investment-called Vendoorn or Kaldor effect.
- The introduction of new capital may lead to a better organization, management and the like and facilitate learning by doing. Thus the testing to 'catch-up' hypothesis in case of group of seven developed countries brings out the convergence of labour productivity, narrowing of differences

in factor intensities (capital: Labour ratios), and convergence of TFP. The positive impact of capital formation on TFP, positive interactions between capital accumulation and technology advance, improvement in organization and management with the introduction of technological advances as well opportunities for learning by doing (all these leading to growth convergence) are the lessons for developing countries to reduce the 'idea gap' and thereby to move towards growth convergence recorded in group seven countries.

2.2.5. **Capital and Growth: Lessons for Developing Countries**:

This section recapitulates some of the major conclusions, inferences on the concept of capital, role of capital in the matrix of deep drivers of growth and in growth / development theories, growth accounting through growth regressions, growth convergence, and to derive lessons / messages for developing countries.

Compared to its early usage, the concept of capital has been broadened and deepened so as to include physical capital, human capital, social capital, natural capital, institutional capital, infrastructure capital and so on. Further three broad deep drivers of growth are labour, capital (in the broad sense), and TFP

There are three broad waves of growth / development theory which graft capital into the matrix of deep drivers of growth-The classical theory of growth, the Neo-Classical and the New Growth theory (NGT). The classical Growth Theory (represented by Harrod-Domar Growth Model) places emphasis on capital accumulation and the embodiment of various forms of technical progress associated with. Further early development economists have also considered the investment a the most important single factor in the growth process as well as structural transformation of the economy of a country. The Neo-classical Theory of Growth disaggregates the sources of growth mainly into labour, capital and technical progress, further, the thrust for economic growth has o come from outside the system, mainly from technological progress which is treated as exogenous. The NGT treats growth as endogenous, arising from intentional actions of economic agents and government. Sustained

increase in growth rate is to be achieved through sustained increase in capital (both physical and human). Human capital would augment the productivity of both labour input and physical capital. The concept of 'idea gap' is quite a useful one to support the inflow of capital and technology to developing countries so as to bride the 'idea gap' necessary for higher growth.

The empirical works on growth accounting through growth regressions have identified physical capital, human capital and TFP as factors to account for variations in growth performance across countries. Further physical and human capital are also identified as explanatory factors for differences in TFP across countries. Added to these, the key reason for cross country variations in growth is identified to be macroeconomic management. Yet, cross country variations in output per worker, even though explained in terms of investments in physical and human capital and in R & D, are explained in terms of social infrastructure (institutions and policies) that would constitute the economic environment for economic agents to decide on investment, creation and transfer of ideas, and production of goods and services. Social infrastructure and output per worker across countries are found to vary directly. Further the testing of catch-up hypothesis with data from seven developed countries with time series data for over 100 years has identified the convergence of capital intensity, labour productivity and TFP. The bridging of 'idea gap' to experience high growth rates is found to have been accomplished in group seven countries through convergence of capital formation, positive interaction between capital accumulation and technology / management advancement and increased labour productivity as well as TFP. These growth convergence experiences are the lesson for developing countries.

From the examination of growth / development experiences across the countries, capital accumulation (in the broader sense of the term) stands out as one of the major deep drivers of growth, and all these would require investment. The growth accounting regression study across broad groups of developing countries would illustrate the importance of capital vis-à-vis other drivers of growth (Senhadji 2000)

Table 2.1: Sources of output Growth by Region of the world: 1960-94

Region	Annual output growth (%)	Contribution of			
		Capital	***Labour***	***Human Capital***	***TFC***
1. South Asia	4.66	2.87	0.99	0.25	0.55
2. East Asia	6.49	4.50	1.27	0.44	0.28
3. Sub-Saharan Africa	2.83	1.79	1.39	0.22	-0.56
4. Middle East and North Africa	5.05	3.99	0.84	0.25	-0.03
5. Latin America	3.42	2.31	1.22	0.28	-0.39

It could be seen from the Table that:

- Capital accumulation is by far the most important contributor to measured growth in output in all the regions. The study on South Asia, East Asia, and Latin America for the years 1960-87 by the World Bank (1991) had also come to the same conclusion.

- Yet another study by HU, et.al (1997) by investigating the sources of growth in China for the period 1953-1994 confirmed the dominant role of capital and productivity. Perhaps for this reason Collins (1996) argues that the marginal product of physical capital is higher in developing countries.

- The negative contribution of TFC in three study regions for output growth is a disturbing trend. However the results of this study are to be considered with caution, due to problems of measurement of inputs consistency / reliability of time series data, and pooling of data across countries to

develop region wise data set. But the role of capital as a major deep driver of growth needs to be recognised.

The developing countries are to get the message that all types of capital could contribute for increased output and productivity. All these would require investment by different economic agents. Capital accumulation is not only important in its own right, it is the major conduit for advances in knowledge, which in turn are major determinants of productivity and output growth. In fact, capital is the main vehicle for the introduction of technical progress in the productive system. The Embodiment Effect, the Vintage Effect and Kaldor Effect of investment would reinforce this argument.

Capital formation and structural transformation of an economic system (Fisher 1939, Johnston 1969) tend to move together. Structural transformation is one of the major indicators of the development status of a country.

In developing countries with low capital-output ratio, the very act of capital deepening (giving each worker a little more capital work with), may make a substantial difference to output growth, and productivity (both partial and total). Details on this issue will be elaborated under section 4 of this report.

Capital accumulation is considered as an escape from the 'vicious circle of poverty' – a circle of low productivity leading to a low level of capital accumulation per head, leading to low productivity. Low productivity is considered as the source of 'vicious circle of poverty', where the circle must be broken by capital accumulation and its efficient use.

In the context of investment in capital, World Bank Report (1994) emphasizes both increases in quantity of infrastructure (transport, power, irrigation, sanitation and so on) in developing countries, but also the quality of infrastructure.

A part from the issue of capital formation and its efficient use, development economists have also brought out other obstacles to development such as dualistic structure of development, circular and cumulative caustion (Myrdal 1957, 1966), geographic determinism (Krugman 1995), unequal exchange between rich and poor countries (Emmanuel 1972), and many other obstacles. In addition to all these, the problem of 'idea gap' in promotion and sustainability of growth should be addressed by developing countries, as done successfully by Japan, and being addressed effectively by China.

3. **Nexus Between Growth And Poverty**:

Since 1970s, one of the "Grand issues" of development has been poverty in developing countries, and since 1990s the slowdown in poverty reduction, inspite of unprecedented high growth rates in some of the major developing countries. This has intensified the global concern for persistent poverty in some developing countries. This concern is much more reinforced by UN Millennium Development Goal for poverty reduction.

Given this backdrop, the need for examining the nexus between growth and poverty is imperative. The proximate drivers of poverty are said to be growth, inequality and population. Growth and distribution inequality determine the rate of poverty, population then determines the number in poverty. In fact, inequality (the distribution of income), growth and poverty form the three vertices of a 'triangle' arithmetically connected in a fairly straight forward way (Bourguignon, 2003. Details on Kuznets inverted U-relationship between growth and inequality in Kuznets 1955, 1963)

Do benefits of economic growth diffuse automatically to the poor? An important premise of early development theory was that the benefits of economic growth would trickle down to the poor automatically. This was the dominant development thinking in the 1950s and 1960s. But by the early 1970s, the trickle down theory

lost some of its relevance, and it has been agreed that growth is a necessary condition, but not a sufficient condition for poverty reduction (Details later). Adelman et.al (1973) was one of the earlier studies to question the automaticity of the relationship between economic growth and benefits to the poor. And then came the influential contribution by Chenery et.al (1974), focusing on the importance of redistribution alongside economic growth. Ahluwalia, et.al (1979) have examined the relationship between growth and poverty in developing countries. Although the output of the world economy had expanded at an unpredicted rate since the middle of 1950s for about a quarter century, and developing countries were also partners in increasing global economic growth, the benefits percolated to the poor were very limited. Further, this failure was because the distributional pattern of past growth had left the poorest groups outside sphere of economic expansion and material improvement. The study also concluded that there is mounting evidence that the growth processes under way in most developing countries are such that incomes of the poorer groups increase more slowly than the average. Perhaps, this observation is also relevant for the period of economic reforms in globalization syndrome across developing countries.

3.1. Recent Evidences on the Nexus: Some Empirical Evidences and Typologies

The first step in examining recent evidences on the nexus between growth and poverty is to discuss three studies (Datt et.al 1992; KaKwani et.al 2000; Kakwani 2000), relating to the methodology of analyzing the impact of growth on poverty. Datt et.al (1992) propose a methodology of decomposing change in poverty into growth effect and distribution effect. The growth effect refers to change in poverty due to change in mean income alone (controlling income distribution effect), and the income distribution effect refers to change in poverty due to income distribution alone, controlling growth effect. This methodology would answer the question how much of any observed change in poverty can be attributed to changes in distribution of income, as distinction from growth in average incomes. This also implies that the increase in average incomes reduces poverty and the increases in income distribution inequality increases poverty. The

magnitudes of two components provide the relative sensitivity of poverty reduction to growth and distribution inequality. If the growth component dominates over the distribution inequality component, then growth maximizing policies and strategies may be adequate in achieving a rapid reduction in poverty. If the distribution inequality component dominates, then policies and strategies should be one of pro-poor growth. Further it is also argued (Kakwani, 2000) that low initial inequality will have a greater poverty reduction effect of growth, where as countries with high initial inequality will have a greater poverty reduction effect from pro-poor growth policies / strategies. These are illustrated with typologies of experiences:

First, Thailand is said to be a country with high distribution inequality and rapid economic growth. Consequently, the rate of poverty reduction has been much slower. Hence, growth-maximizing policies and strategies alone will not be sufficient to achieve rapid reduction in poverty.

Second, Republic of Korea (even Lao PDR) is a nation with high economic growth and low distribution inequality. In this case, growth-enhancing policies and strategies may be adequate to reduce poverty.

Third, Philippines is a country with lower economic growth higher distribution inequality. A situation like this needs an appropriate mixture of growth-maximizing and pro-poor-growth policies and strategies.

All these three typologies of experience leads to the major development lesson that the impact of growth on poverty depends on levels of distribution inequalities in assets and income. Ravallion (1997) has found that poverty elasticity growth is lower, the higher the initial level of distribution inequality. Thus initial distribution inequality is one of the very important factors in explaining differences in poverty reduction in different countries. That is why Deininger et.al (1998) concludes that initial distribution inequality hurts mainly the poor, but not the rich.

Yet another way of looking at the issue of nexus between growth and poverty is who (the poor or rich) stands to gain more from growth. The study by ESCAP(2008) of the case of Thailand answers this question, but not for generalization. Thailand's almost 10% GDP growth rate per year during 1988-1992 did not proportionately benefit the poor. During the financial crisis years of 1996-2000, the worst affected were the poor-Poverty increased sharply from 11.4% in 1966 to 16.2% in 2000 (Son, 2003)

The study by Rizwanul (2004) also suggests different combinations of growth and poverty reductions. Indonesia, Vietnam and Uganda represent a case of high GDP growth rates and high rates a poverty reduction, Bolivia medium growth rates and high rates of poverty reduction, India high growth rate and low rates of poverty reduction, and Bangladesh medium growth rate and low rate of poverty reduction. These different experiences are due to choice of sectoral pattern of growth, initial distribution inequalities, employment generation effects of growth pattern and so on. Kanbur (2004) has examined the variability of performance of different systems (Statist model and Market model) in growth and poverty reduction during the last decade, and concludes that a key factor underlying this variation in performance in growth and poverty reduction is the performance of institutions, broadly defined political, social and economic institutions.

3.1.1 **Reinstatement of Growth-Maximization approach to Poverty Reduction**:

Recent cross country studies argue that growth and poverty reduction are positively related. It is argued that growth tends to reduce absolute poverty (World Bank, 1990; Ravallion et.al 1997; Fields 2001; Karry 2004). Yet in another study by Ravallion (2000), it is inferred that the elasticity of poverty to growth is negative, impliying an increase in growth rate would reduce poverty in the head count index of poverty. But there are also voices of caution (Cline 2004; Khan et.al 2006), indicating weaker-thank-expected response of poverty levels to growth.

A Stronger version of the positive relationship between growth and poverty reduction (Via income distribution) is by Dollar et.al (2000); the study with an empirical examination of the relationship between growth and income distribution across 80 countries over 40 years has found that income of the poor (the bottom 20% of the population) rises one-to-one with overall growth, and the relation is no different in poor countries than in rich countries. In other words, growth seems to benefit the poor as much as the rich so that relative inequality (the Gini ratio) stays the same. But the absolute inequality still widens, because the same growth of income gives more dollars to a rich than a poor person.

Naqvi (1995), based on the study of 40 developing countries, tends to come to the conclusion that high growth rates and distributive justice move together. These lines of arguments would provide a strong case for growth-maximizing policies and strategies, and Governments may not follow pro-poor growth policies. This argument that Governments need not follow pro-poor-growth policies appears to ignore the problem of absolute poverty in developing countries which very much warrants pro-poor-growth policies and strategies (Eastwood et.al 2000). It is also not clear whether cross-countries studies by pooling data of different countries with varied socio-economic-political matrix would cloud the relationship between growth and poverty.

3.1.2 **Counter to Growth-Maximizing Alone Approach**:

If there is one-to-one correspondence between growth and poverty, how one would account for the persistence of high incidence of poverty despite unprecedented growth in developing countries like India. There are studies (Ex.Fields 1999) to indicate that the poor gain proportionately less than the average individual. These results are at odds with results of Dollar et.al (2000) study. The study by Foster.et.al (2000), using social welfare approach casts doubts on the result that the income of the poor rises one-for-one with over all growth. Perhaps growth is good for the poor, but it is decidedly by better for other segments of the society. This supports the concept of pro-poor growth and the concept of 'Growth plus Interventions' approach (Weises et.al 2006), because benefits of growth do not

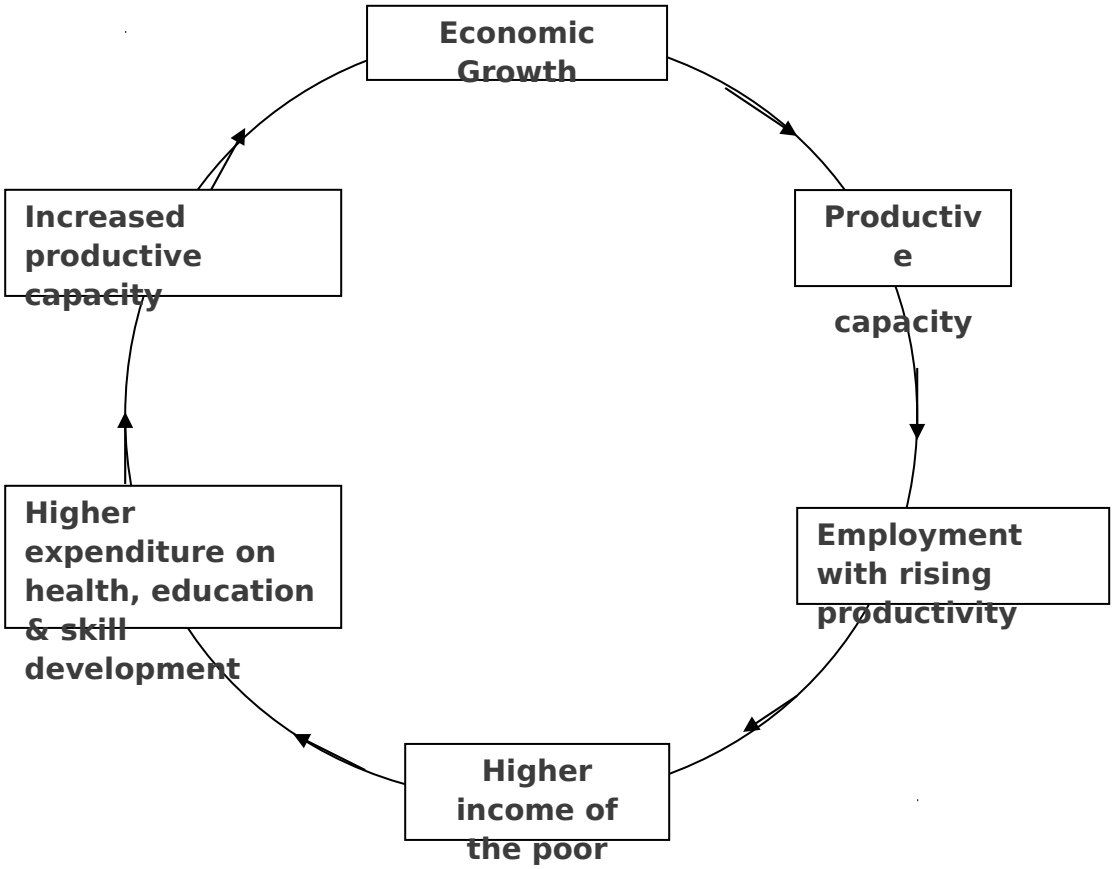
percolate automatically to the poor. This argument is relevant for translating growth into development. Development without growth is not conceivable, but growth is possible without development.

In the context of counter to the arguments of Dollars et.al (2000) and other, it is also relevant to consider two general conclusions of the study by Fields (1999). First 'nearly always economic growth has reduced poverty'. Second, 'when poverty has not fallen, it is usually because economic growth has not taken place'. Both the conclusions are some how contrary to growth/development experiences of some of the developing countries like India.

3.1.3 **The growth-poverty relation debate is not conclusive:** because different methodologies have led to different inferences. But this debate supports both growth-maximizing and targeted poverty-reducing policies and strategies for developing countries. But a fine balance of combinations of both is needed, with a proper choice of pattern of growth keeping in view sectoral and social distribution of poverty (Details in section 4) This is absolutely needed as a part of pro-poor growth framework, and this framework is supported, among others, both by Asian Development Bank and U.N.Millennium Development Project 2005 (Hughes, 2008). It is because economic growth is no longer treated synonymous with economic development, as it was upto 1970s. When the 'inadequacy' of growth alone for reducing absolute poverty is recognised, attempts are to be directed towards pro-poor growth and human development through pro-poor growth

The International Futures, a large scale integrated global modeling system (Hughes et.al 2008) representing 182 countries emphasizes, among others, that humans as individuals should be able to develop their capabilities, attaining literacy, securing nutrition and health care, and gaining access to basic level of economic resources (similar to livelihood security concept in Bisaliah, 2009). In this perspective, pro-poor growth is to be recognised as one of the pillars of sustainable human development. The goal is to move beyond income poverty and look much more broadly to capabilities-based measures.

In this quest for elements of pro-poor growth, Rizwanul (2004) places emphasis on augmenting productivity of labour force in developing countries by providing more capital for labour to work with. Employment mediates between growth and poverty, and the following virtuous circle illustrates these relationships.



That explains why generation of employment is argued to be put at the centre of development agenda (Bhaduri, 2008). Jobless growth will not forge the positive relation between growth and poverty reduction, and the case in point is organized sector of India, and to some extent China also.

4. **Capital Formation, Agricultural Growth and poverty Alleviation**:

Recapitulation of results / inferences on capital and growth (section 2) and the nexus between growth and poverty (section 3) is in order, before the analytical and empirical issues related to capital formation and agricultural growth, and agricultural growth and poverty alleviation are outlined.

- First, a search for sources of growth both in theoretical and empirical studies has led to the conclusion that the capital (a broad concept) is one of the critical factors for growth. In all the three waves of growth theory-classical, Neo-classical and New Growth Theory (Endogenous Growth Theory), the role of capital has turned out to be crucial for growth. Among other forms of capital, human capital, knowledge capital, and physical capital, and institutional capital would form a set of crucial forms of capital for growth.

- Second, growths accounting through growth regression studies have also concluded that capital is crucial for 'catch up' in growth path and for growth convergence. Failure to 'catch up' through capital accumulation and technological advancement (investment is needed for 'catch up'), growth divergence, labour productivity divergence and divergence of TFP across countries would persist. Hence investment in capital is needed for 'embodiment, 'Vintage' and Kaldor effect to take place in growth process. Further 'idea gap' continues to persist between countries leading to growth divergence, in the absence of adequate amount of capital accumulation.

- Third, developing countries are to realize that capital accumulation is by far the most important contributor to measured growth of output in South Asia, East Asia and Latin America, as identified in a region wise study of sources of output growth. Capital accumulation is important in its own right for these countries, but it is the major conduit for advances in knowledge / technology, which in turn are major determinant of productivity (both partial and total) and output growth. Capital deepening (giving each worker a little more capital to work with) would make a substantial difference to productivity and output growth. Added to all these, capital accumulation is considered as an escape, from the 'Vicious circle of poverty'.

Fourth, a study of debate on the nexus between growth and poverty suggests that the benefits of economic growth generally do not trickle down automatically to the poor. The decomposition analysis of change in poverty into growth effect and distribution effect suggests that the impact of growth on poverty depends on

relative strength of these two effects. Dominance of growth effect over distribution effect would lead to rapid reduction of poverty, but the dominance of distribution effect over growth effect would lead to slow down in poverty reduction. This would suggest that pro-poor growth policies and strategies will have a greater poverty reduction effect. Hence the empirical evidences are mixed in the sense that different combinations of growth and poverty reduction are observed across different developing countries. The emergence of different combinations is due to choice of sectoral pattern of growth, initial distribution inequalities, and employment generation. However, inadequacy of growth alone for poverty reduction is recognized, and "growth plus intervention" strategy is suggested. In the quest for elements of pro-growth, productivity-augmentation of labour force in developing countries by providing more capital to work with in agricultural sector is important in view of the fact that poverty is dominantly a rural phenomenon.

4.1. **Agriculture as a Leading Sector in Development Agenda**.

The imperatives for reinstating agriculture / Rural sector at the centre of development agenda of developing countries could be examined from many perspectives.

First is the spatial and social distribution of poverty (Bisaliah, 2009). In regard to spatial distribution of poverty at the global level, South Asia and Sub-Saharan Africa are the hunger spots (Section 1). Further, poverty is dominantly a rural phenomenon in these regions. It is estimated that 70% of the people of food insecured regions (ignoring livelihood security) are in rural areas. With respect to social distribution, small holders, landless labour, and women and children would form a bulk of food deprived people.

Second, in view of "parking of" bulk of the poor in rural areas, growth of agro-rural sector is crucial for poverty alleviation. Since agro-rural sector is the predominant provider of employment for the rural people, and about 60% employment generated in developing world is from the agricultural sector, agricultural production / productivity is likely to have a significant impact on poverty (Majid, 2004). If there is any sector that helps in achieving maximum poverty reduction goal directly it ought to be agriculture sector. In fact, one of the major development experiences of India is recent emergence of service-led

growth and decelerated growth of rural sector; as a result India is not in a position to 'honour' Millennium Development Goal of halving the number of poor profile by 2015. In this regard, a disportionately high share of the service sector in GDP in many countries such as those in South Asia is considered a cause for some concern (Tisdell, 1999).

Third, high growth performance of agriculture sector is likely to trigger Rural Non-farm (RNF) activities which could lower rural unemployment and rural poverty (Lanjouw et.al 1995; Saith, 1992). This is the development multiplier effect of agricultural growth.

Fourth, in the Lewis Model (1954, 1955, 1958) there is an explicit treatment of the interaction and complementarity between agriculture and industry in terms of 'release of labour' to industry and demand expansion from rural sector as a stimulous to industrial growth. Further, agriculture should not be seen as static and its change has been a major factor in the long-run process of economic growth / development (Mellor 1976; Lipton 1977)

Fifth, higher productivity growth leading to higher food grain output (or any other food product) results in lower food prices benefiting the poor (Hayami et.al 1977; Alauddin et.al 1991). More recent literature provides ample evidence of the poverty reducing effect of higher agricultural growth resulting from higher productivity growth (Datt et.al 1999; Fan et.al 2001). Further it is convincingly argued that agricultural productivity growth generates higher income for poorer farmer (Hayami et.al 1985; Lipton 1977)

Sixth, no developed economy became so without agricultural sector recording substantial productivity gains. There is some historical evidence that agricultural revolution preceded industrial revolution in countries like Japan. It has been tracked that pre-war agricultural growth supported the post-war industrialization of Taiwan and South Korean (Correa 2008). Cross country studies (Correa 2008) which seek to track the sectoral sources of growth have concluded that dynamic agriculture has the strongest linkage to growth in other sectors and aggregate growth. Many developing countries have a long way to go in this type of transition (see Bose 2007 about India's problem of transition). Perhaps some developing countries are passing through 'Grand Tension' in passing through a right track of growth transition.

Seventh, a recent study by ESCAP (2008) has brought out clearly the critical role of agriculture for rural development and poverty reduction in ESCAP region. But decelerated agricultural growth has undermined the capacity of the region to reduce poverty and inequalities which are the major development policy goals.

Eight it is true that faster economic growth is one avenue for reducing poverty. But growth maximizing development policy may not always lead to maximization of poverty reduction. Instead it is growth pattern and sectoral composition of aggregate output growth which would contribute for a higher rate of poverty reduction (Ravallion 2000); because poverty has both spatial and social dimension. Hence growth efforts to be directed to areas where the poor people live, sectors in which poor people work, to the factors of production they possess, and to the products they consume. Because majority of the poor live and work in rural areas, have little education, provide unskilled labour and consume mostly basic necessities such as food, rural growth becomes the nodal strategy to promote this pro-poor growth. Wars (2000) who argues that overall rate of growth is over whelming important determinant of poverty reduction and sectoral composition of growth may be less important will have to subject its conclusion to further research scrutiny which he himself admits. Hence for developing countries agriculture is conceded in general as a pro-poor growth sector, and hence to be treated as a leading sector for poverty reduction and for reducing growing distribution inequalities.

4.2. **Agricultural Growth and Poverty Reduction: Cross country Experiences**.

The preceding section, has argued for treating agriculture as a leading pro-poor sector, and for increasing productivity and production in this sector. This section examines some of the inference drawn in empirical cross country studies.

4.2.1. In developing countries, there has been a general decline in agricultural productivity and labour productivity and slow down in poverty reduction since early 1990s. There is likely to be a deeper link between agricultural / labour productivity and poverty reduction. How else China could experience a concomitant maintenance of high labour productivity in agriculture and continued poverty reduction beyond early 1990s. Further China development experienced suggests that growth in TFP in agriculture and high level of

labour productivity are both crucial for poverty reduction (Majid 2004). In fact, the growth performance of agriculture in China has mathched with general growth performance of the economy. On the otherhand, sub-Saharan Africa has registered worst growth performance in both agricultural labour productivity and TFP in agriculture. This has generated a development experience typology of low labour productivity and low TFP and stagnant trend increases in poverty in sub-Saharan Africa. This cross country experience suggests that growth in both labour productivity and TFP would lead agriculture to impact positively poverty reduction. However it is difficult to generalize; because the impact is negative in Latin America, and extremely weak in South Asia.

4.2.2. There is a body of growth accounting literature on agriculture that is devoted to systematically accounting for growth in labour productivity, using capital intensity, human capital, land quality and other factors. The studies by Craig et.al (1997) and Thirtle et.al (2002) have attempted to measure the influence of agriculture R & D expenditure on growth in productivity. In a fairly comprehensive and influential study Hayami et.al (1985), while elaborating the role of agriculture in development, have provided estimates of land and labour productivity for a large number of countries and then have explored the causes of productivity differentials across countries. Much of their analysis has focused on labour productivity and its determinants in the form of changing land-labour ratios, the use of fertilizers and tractors in agriculture production. Hayami (2002) has reinforced the importance of these sources of growth in agriculture. Cross country labour productivity differentials are also examined (Kawagoe.et.al 1985; Lau et.al 1989) in terms of farm scale, education and research.

4.2.3. Instead of focusing only on labour productivity in agriculture there is a need for focusing on growth of TFP also. Some of the major findings from cross country studies are as follows?

- Labour productivity and TFP in agriculture together could impact poverty reduction.
- What factors would influence TFP?

- Craig et.al (1997) have investigated the role of input quality, infrastructure and research in explaining TFP growth. Improvements in skills of agriculture labour, better quality fertilizers, tractors with greater horse power and better seed varieties are examples of technical input quality that have direct bearing on TFP.

- Majid (2004) has examined TFP augmentation by considering institutional, policy and structural factors. This seeks to explain variations in TFP in agriculture across 52 countries by considering a number of economic, geographical and institutional factors-effects of macroeconomic policy, education, quality of governance, geography and so on (Details in Majid.2004). The study has identified the negative impact of wrong Government policy, illiteracy and prevalence of deadly diseases (like Malaria) and geographic isolation on TFP. The areas that are identified to increase TFP are investment in human capital through increased outlay on education and health, improvement in physical infrastructure for rural sector, implying more of public investment. Since agriculture labour productivity is negatively related to poverty, augmentation of labour productivity through increased TFP (or otherwise) is crucial.

- The study by Prasad et.al (2004) has focused on agricultural productivity growth, employment and poverty in developing countries, drawing, data (for a period of over three decades) from 111 countries covering more than 95% of global agricultural output and 98% of the world population (see Prasad et.al 2004 for details on data, definition and measurement of variables and methods of analysis). The major relevant findings of the study are as below:

- The agricultural productivity variable-both partial productivity ratios and TFP exerts a significant ameliorating influence on incidence of poverty. Further, percentage of rural population and institutional factors such as policy and corruption also exert significant influence on poverty.

- In view of dominant influence of TFP on agricultural productivity, what factors would affect TFP? The regression results suggest that irrigation, Government expenditure, and export (export as a percentage of GDP), a proxy variable for 'openness', are found to have significant positive influence on TFP. The countries with 'openness' in their economic policies have higher TFP levels in agriculture, perhaps due to more of technology transfer under 'openness' regime. The negative impact of illiteracy on TFP is very well observed. Land quality and geographical distance are also found to have bearing on TFP.

- In case of Asia, Africa and Latin America, institutional, political and macroeconomic variables are also found to have strong influence on TFP in agriculture.

- A comparison of TFP growth in China and India between two periods of time (1970 vs 2000) would be quite contrasting compared to USA with 1.00. The TFP in Chinese agriculture increased from 0.29 in 1970 to 0.45 in 2000, where as in India TFP had deteriorated from 0.32 to 0.25 during the same period. However large gap in TFP between USA and these two countries is quite evident. China with a very average performance until the mid 1980s, suddenly gathered momentum in TFP growth acceleration, in addition to efficiency change and technical change.

- Developing countries are advised to increase TFP in agriculture by increasing investment in human capital, investment in improved physical infrastructure. Investment in agriculture R & D, by promoting greater foreign trade, and by attracting foreign direct investment for rural sector, of course by enforcing appropriate regulatory guidelines.

4.2.4. Both in China and Vietnam, agricultural growth has reduced poverty. Emphasis on agricultural growth did not sacrifice growth; on the other hand it drove growth. Rural growth spurred farm and non-farm enterprises that boosted employment and incomes, creating virtuous cycle of growth and poverty reduction. However, there are evidences on growth performance of China (Pasha 2002) to suggest that during the early, 1980s

China's agriculture-led development strategy was highly pro-poor, but when China shifted its strategy oriented towards exports and foreign direct investment, growth became less pro-poor and poverty reduction slowed (ESCAP 2008). In case of Vietnam, with the introduction of land reforms (dismantling collective farms) and abolition of price controls, there was a spectacular growth in the 1990s, reducing poverty (Kakwani et.al 2004). This leads to the same development experience that it is not only the overall growth that determines how much poverty is reduced, it is also pattern of growth.

ESCAP study (2008) has brought out some useful development experiences relating to agricultural growth and poverty reduction.

First the share of agriculture GDP in overall GDP has declined since 1990s in ESCAP Region due to low productivity of agriculture, leading to lower employment and income opportunities for the poor. On the other hand, the number of people depending on agriculture has not declined as rapidly as the share of agriculture GDP especially in countries like India (Timmer 2005).

Second, declining labour productivity in agriculture is yet another development experience of the Region since 1990s. Raising average agricultural labour productivity in the Region to that in Thailand could take 218 million people out of poverty. Agricultural labour productivity growth of 2.5% in 1980s dropped to 1% during 2000-02. The main reason for this decline in labour productivity was stagnation of productivity growth in agriculture

It is estimated by ESCAP (2008) that 1% increase in agriculture labour productivity would reduce the number of poor by 2.37 million in ESCAP Reason.

Third, the potential gains from higher productivity in agriculture are large. For example, a percentage point of additional growth in agricultural GDP per capita in South Asia would reduce poverty head-count 3.85 times more than an additional percentage growth outside agriculture in the region. Further ESCAP (2008) has estimated that raising agricultural productivity to the level of Thailand could reduce inequality measured by the Gini coefficient by 6%

Fourth, to emphasize the importance of agriculture labour productivity on poverty reduction, ESCAP (2008) estimates would provide additional evidence. It is estimated that 1% increase in agricultural labour productivity would lead to a 0.37% drop in poverty in the Region. For example, it is estimated (Fan et.al 2003) that the agricultural labour productivity elasticity of poverty is -0.417 for Thailand.

Fifth, agriculture sector could be a powerful engine for reducing poverty and ensuring social equity. Then what is holding back agriculture in the region? Structural constraints like inequality in land ownership, lack of human capital development, inadequate rural infrastructure, policy constraints such as anti macroeconomic policies, failures in agricultural credit system, and lack of adequate investment in R & D and extension services. In fact, agriculture R & D, education of the rural people, and rural infrastructure particularly electricity and roads are key determinants of productivity in agriculture and have a major impact on poverty reduction (Fan et.al 2003). To make agriculture socially and economically viable, and to promote inclusive growth, capital investment is needed for developing markets, human capital, augmenting R & D capacity, irrigation and water management and development of rural growth centers to provide non-farm employment and income opportunities so as to diversity their income sources and insure against shocks to their agricultural incomes (McCullock et.al 2007)

4.3. **Capital Formation**: **A Major Driver of Agricultural productivity and Growth**:

It is recalled from earlier sections that:

- Aggregative economic growth is far from adequate to address the development problems like poverty, inequalities and unemployment in developing countries. Agriculture / Rural growth could be 'remedy' for some of these problems, because agriculture / rural growth is treated as pro-poor, and poverty is dominantly a rural phenomenon.

- Cross country agricultural growth and poverty reduction studies suggest the closer link between decelerated agricultural output / productivity growth and slowdown in poverty reduction.

- Growth in agricultural labour productivity and augmentation of TFP could have larger impact on poverty reduction. For example, a rise in the average agricultural labour productivity in the ESCAP Region to the level of Thailand could take 218 million people out of poverty in the region.

- The determinants of TFP are irrigation, Government expenditure on agriculture, rural infrastructure, human capital, agriculture R & D and so on. All these determinants would need capital formation in/for agriculture. Further investment for the development of non-farm sector in rural sector would be equally important for increasing and diversifying employment and income opportunities for the poor in developing world. Hence capital (in the broader sense) is one of the major drivers of agricultural productivity / growth, and there by poverty reduction. Capital formation, structural and policy constraints need to be addressed to achieve the development policy goals.

4.3.1. **Debate on the concept of Capital Formation in Agriculture**:

The United Nations concept of capital formation includes tangible reproducible assets destined to be used in future production (Hooley, 1967). Agricultural implements and machinery land improvements, laying of new orchards and plantations, irrigation and other constructions, and so on perhaps could be included as forms of capital formation in agriculture. Based on a study of capital formation in agriculture of 62 countries, Larson et.al (2000) have considered fixed capital in agriculture, capital in orchards (tree stock), and capital in livestock as components of capital formation in agriculture. These components account for most of agricultural capital. However National Accounts usually report fixed capital investment, which does not wholly include livestock and tree stock. Further while estimating agriculture capital stock the issue whether agricultural land be included (as discussed in Wilcox 1943), or investment in improving the productivity of land alone be included is being debated. One of the major issues in capital formation is compositional shifts in capital formation with structural transformation of the economy. To illustrate this points some of the results of the study by Larson et.al (2000) could be used. Ratio of livestock and tree capital to fixed capital in agriculture in a study of 62

countries could be one of the ways to gauge compositional difference in capital formation broadly between two groups of countries.

Table 4.1: The Ratio of Tree Stock and Livestock to Agricultural Fixed Capital (Averages over 1967-92)

Country	Tree stock	Livestock
Canada	0.009	0.140
France	0.263	0.245
Japan	0.078	0.013
USA	0.055	0.223
New Zealand	0.033	1.011
India	0.208	1.758
Indonesia	5.569	3.014
Keneya	0.909	3.876
Pakistan	0.295	1.587

Note: See Larson et.al (2000) for methodology of constructing fixed capital, tree and livestock capital series.

One major observation on the results in Table 4.1 is related to compositional difference in capital formation between developed and developing countries. The capital accumulation from fixed capital (machinery, irrigation, building etc) is found to be more important than capital of agricultural origin such as livestock and tree stock in developed countries. In view of declining importance of livestock and tree stock vis-à-vis fixed capital, agriculture has become more capital intensive in these countries. In developing countries, live stock capital is found to be still more important vis-à-vis fixed capital, and tree stock capital in countries like Indonesia is more important than fixed capital, and tree stock capital in Kenya is at least as important as fixed capital. This may also imply low fixed capital base for agriculture in developing countries. The relationship between fixed capital stock and productivity of agriculture in different countries will be discussed later.

4.3.2. It is also appropriate to examine the shifting composition of agricultural capital historically, based on an important study by Tostelbe (1957) on USA. The study has considered growth of real farm capital measured under four major categories viz land and buildings, machinery, livestock and stored crops. The study on the capital growth centers on the interrelationships among three variables – farm capital, labour and product. A few of the results of this study are relevant in the context of the present study:

- First, the percentage share of implements and machinery in total capital stock increased from 4% between 1870 and 1910 to 37% between 1910 and 1950. Further, the historical study also infers that land because less important and machinery and power some what more important in the whole of physical farm capital. During the Second World War, the need for increased output coincided with an acute labour shortage on farm; as a result farmers added to their stocks of machinery at unpreceded rate. As a result of these, mechanical technological innovations, farmers could produce farm output at an increasing rate, even though there was a decline in factors of production such as labour.

- Second, output per unit of capital increased slowly until 1920. Then the increase accelerated so that by 1950 output per unit of capital was 40% higher than in 1950. Further productivity of labour (output per person engaged in agriculture) was upward throughout the study period due to capital deepening in agriculture (More details in the subsequent sub section). The chief factor that accounted for the persistent rise in output per agricultural worker was the simultaneous rise in capital per worker.

  The lesson from the examination of this historical study is quite obvious for developing countries, the large and continuing importance of capital as a determinant of productivity of labour is to be recognised in the perspective that one of the avenues to address the problem of poverty in rural areas is to increase the productivity of labour engaged in agriculture. The developing countries have to realize the physical capital assumes meaning only with a given technological and institutional framework. A study of Easterly et.al (1997) has found that the conventional factors of growth alone do not fully explain Africa's experience, and

hence institutional factors like agrarian structure, land distribution etc are also relevant. Hence the role of capital formation in a agriculture growth has to be examined in its totality, including technological and institutional factors.

4.3.3. There are three major stages identified with respect to capital formation in agriculture (Perkins, et.al 1961):

First, there is a large subsistence segment in agriculture with less of market orientation with a scarce capital supply coupled with unused land and labour resources; the development situation would call for investment of surplus labour in capital creating projects.

Second, social overhead capital becomes exceedingly important, when development environment is dotted with less of unused natural and labour resources. This environment would need the support of social overhead capital in the form of education, training programmes, research and extension efforts so as to 'produce' and use land-saving technological resources for increasing the level of agricultural productivity. That would also create better climate for private investment in agriculture. Japanese Model of agricultural growth by developing and using land-saving technologies like investment in irrigation, and bio-chemical inputs could be an example. To overcome the scarcity of land investment in land substitutes like irrigation and production of bio-chemical inputs are made.

Third, this is a stage of developed agriculture in which wage rates are increasing, and capital has to be substituted for labour in the form of 'labour saving' technologies in the form of mechanical technologies. In this development stage, capital deepening takes place. The American Agriculture Growth path may illustrate this situation.

But in developing countries, combinations of all these three stages may co-exist, with consequent differences in capital formation pattern requiring proper investment decisions.

4.3.4. **Capital Deepening for Agricultural Growth**:

It is recapitulated from section 4.3 that growth in agricultural labour productivity and augmentation of TFP could have a larger significant impact on poverty reduction. But the

growth of both labour productivity and TFP would need capital deepening, in the sense more capital is needed to accomplished growth in both the fronts and thereby to experience higher growth of agricultural output. But low level of capital accumulation (in the broader issue) in agriculture is one of the distinguishing characteristics of developing countries.

The following data illustrates less of capital deepening in agriculture – less of capital items like agriculture machinery (Tractor as a proxy for agriculture machinery) in developing countries vis-à-vis developed countries.

Country	Tractors per thousand agricultural workers (1995-97)	Agricultural productivity per agricultural worker (1996-98in USD)
1. Bangladesh	-	276
2. India	6	406
3. Brazil	57	4081
4. Japan	637	31094
5. Germany	991	22759
6. Italy	913	20031

Source: World Development Report (2000)

It follows from the data that capital intensity and labour productivity in agriculture generally vary directly. It is realized that labour productivity in agriculture depends not only on agriculture machinery, but also on human capital, social capital, institutional capital, natural capital and so on. Further, the determinants of TFP (which may have bearing on labour productivity) are irrigation, Government expenditure on agriculture, rural infrastructure, human capital, agriculture R & D. As discussed under section 4.3, all these would need capital formation in/for agriculture; added to this is the need for capital investment to support non-farm sector development in rural areas to diversify and enlarge employment and income opportunities for the poor.

To support this reasoning empirical results from Table 2.1 of section 2.2.5 on growth accounting could be recalled. The aggregate growth accounting regressions across broad groups of countries would illustrate the importance of capital vis-à-vis other drivers of

growth. Capital accumulation is by far the most important contributor to measured growth in output in all the countries. The country studies of Israel (Sadan 1968) and on China (Chow 1993) would also illustrate the importance of capital in the matrix of deep drivers of growth.

4.3.5. **Agricultural capital stock, labour productivity, and prevalence of Hunger in Developing Countries**.

It is appropriate to state major results of three studies FAO (2001), Stephan (2009), and Schmidhuber (2009) on Agricultural capital stock (ACS) productivity of labour engaged in agriculture, and prevalence of hunger in developing countries. This is to establish the relationship between ASC, productivity of labour and hunger in developing countries.

These results would reinforce the argument that ACS tends to have positive impact on productivity of labour in agriculture and thereby negative impact on prevalence of hunger in developing countries.

- It is found that there is a tendency for low ACS per worker, low labour productivity and high prevalence of undernourished population to 'co-exist'.
- The regions with low capital intensity per agriculture worker showed a low productivity per worker.
- The value added per worker in the group of countries with the lowest percent of the population undernourishment was 2.0 times higher than in the group of Countries with highest level of undernourishment.
- Between 1975-2007, the average annual growth rates in ACS was 1.33% in Latin America and Caribbean, -0.26% in South Asia, and -0.44% in Sub-Saharan Africa. Further, the rate of growth of ACS per worker was 2.76% in least hunger category of countries, -0.30% in highest hunger category. China had recorded 0.74% growth rate. In brief, the ACS had grown the least in countries with the highest prevalence and depth of hunger.

- TFP growth rate in agriculture between 1975-2007 was the highest (2.1%) in China, and lowest (0.9%) in Sub-Saharan Africa, and 1% in Latin America. (Details on decomposition of TFP into efficiency and Technical change components in Stephan et.al 2009).

- Factors having positive impact on TFP are found to be irrigation development, political regime index, Government expenditure on agriculture, and FDI under some institutional environment like lack of corruption and democratic political structures.

- The outlook study of Schmidhuber et.al (2009) for a period of 44 years (2005/07-2050) has provided some more details on the importance of capital stock in agriculture.

    - The cumulative gross investment requirements for developing countries would come to US $ 9.2 trillion (Component-wise Break-up in the outlook study).

    - Growth accounting analysis suggests that overall growth will be characterized by a growing substitution of Labour with capital and moderate TFP growth. However, in Latin America, growth will be capital intensive, and in Sub-Saharan Africa, growth will be heavily labour and modally capital based.

    - A farmer in Latin America on an average has 10 times more capital available than his counterpart in Sub-Saharan Africa.

    - An important factor that explains difference in output per worker is capital stock per worker. (See Schmidhuber et.al 2009 for other reasons for difference in productivity).

    - It is also argued ICOR could be the basis for deciding where more capital should go. For example the lowest (3.1) ICOR is for Sub-Saharan Africa (average over 2005/07 to 2050). This is also suggestive of higher returns

on investment made in this region. This is consistent with the argument of that marginal productivity of capital is high in capital deficient developing countries.

It is obvious that any country that has experienced productivity growth both partial and total-in agriculture has done so through capital deepening among other supportive measures. But one of the fundamental obstacles to growth//development of agriculture in developing countries is low capital accumulation as well as its efficient use. Given a limited amount of investment resources, the development merit of a sector is to be judged by how much the sector would contribute for addressing the development problems like poverty, unemployment and inequalities, and by how much of development multiplier it would give rise to through inducement effects. Agriculture tends to emerge as a deserving candidate on both the counts of merit. Further the agriculture sector of developing countries is passing though what Heirschman (1960) called 'Grand Tension' in their development process and development disequilibrium. Low productivity of labour force in many of the developing countries due to capital deficiency, among others, has sharpened this 'Grand Tension' in the form of high prevalence of hunger.

5.0 **Capital Formation, Agriculture Growth and Poverty in India**: **Analytical Constructs and Empirical Evidences.**

It has been concluded in the preceding section that the most important contributor to measured growth in agriculture is capital formation, among others like TFP. Further the relationship between ACS, productivity of labour engaged in agriculture and prevalence and depth of hunger in developing countries (Region wise) has also been examined. The major conclusion of this analysis is that high capital intensity (capital deepening) has positive impact on productivity of labour in agriculture, and high productivity of labour leads to low prevalence and depth of hunger in developing countries In this section, the focus is on case

study of India, one of the hot spots of poverty from the angle of both spatial and social distribution of poverty, and where poverty is dominantly a rural phenomenon with over 60% depending on agriculture for employment and income opportunities. Further, India has entered into high growth trajectory, and this has been accomplished mainly through services sector-led growth. The present section is designed to focus mainly on complexity and concerns of Indian agriculture sector, concepts and coverage of ACS, growth of capital stock and its composition, investment behaviour of public and private sector (determinants of capital formation), complementarity between public and private sector capital formation, the relationship between capital formation and productivity / output growth in agriculture, and the impact of agricultural growth on poverty.

5.1. **The context, complexity and concerns of Agricultural Sector**:

An analysis of complexity and concerns of agriculture sector would form a backdrop to the main topic under discussion. Further there are many imperatives for placing agriculture at the centre of the development agenda of the country. The imperatives are large segment of the population depending on agriculture for livelihood, positive relationship between agricultural growth and poverty reduction, key to higher GDP growth rate through supply and demand routes, widening and deepening rural-urban development divide, increasing food insecurity and so on. Keeping these imperatives, the following facets of the context, complexity and concerns of agricultural sector are outlined to search for drivers and directions of agricultural growth (Bisaliah, 2009):

- The complexity of agriculture growth is enhanced by the large number of holdings and their small size. As per Agricultural census of 2000-01, there were120 million holdings of which 83% were marginal and small (100 million holdings) The average size of land holdings had declined from 2.28 hectare in 1970-71 to 1.3 hectare in 2000-01.

- The share of agriculture GDP in national GDP has decreased from 55% in 1950-51 to 17% in 2008-09. But there has been less of a structural transformation, because about two-third of the country's work force continue to depend on agriculture for their livelihood. A recent study by Broadberry et.al (2009) has clearly brought out

the low labour productivity in Indian agriculture vis-à-vis that of U.K. While identifying the Great Divergence of productivity and living standards between U.K and India, the study has convincingly argued that productivity divergence is largely due to low labour productivity performance in Indian agricultural sector. This is the only sector where India has continued to fall farther and farther behind U.K, whereas in service sector there has been an upward trend in labour productivity. Hence India needs to drastically increase agricultural labour productivity if it is to improve its overall productivity performance and to increase the 'catching-up' process in growth performance.

- Added to low agricultural labour productivity is the productivity (measured in terms of productivity per unit of land) fatigue and agricultural technology fatigue in India and falling TFP which in turn have strong bearing in output growth performance. To put in brief, since the period of Economic Reforms from 1991 as a part of structural Adjustment programme, there has been a decelerated output growth in agriculture sector, accelerated growth in Service sector and stagnant / marginally improved growth in industrial sector (Bisaliah, 2006). Growth rate of Agriculture GDP has declined from 3.6% during 1984/85 and 1995/96 to 1.8% during 1995/96 and 2004/05. In a land constraint country where productivity-led growth has to be the major driver of agriculture output growth, productivity fatigue/decrease is bound to give rise to decelerated agriculture growth. In fact, international comparisons reveal that average productivity of land in India agriculture is generally 30% to 50% of the highest average yield in the world.

- As a result of dismal performance of agriculture in both output growth and employment growth in rural sector (Bisaliah 2006), rural poverty is still high (Dev.et.al 2008). A reestimate of poverty in India suggests that about 28% of rural people are below the poverty line when only expenditure on food is considered and the estimate comes to 36% if minimum level of private expenditure on health and education is also included. This explains why report of Expert Group on Agriculture Indebtedness (2007) observes that India is passing through an agrarian

crisis, one of the symptoms is that about 200 thousand farmers had committed suicides between 1997 and 2008.

- Depletion and degradation of natural resource base (land & water) giving rise to biological disequilibrium is yet another concern that needs to be addressed to restore the productivity of agriculture.

- Polarized growth instead of broad based virtuous growth has given rise to growth enclaves, bypassing a large segmentation of agriculture. The outcome of this polarized growth is agricultural segmentation with the rural affluent elite, dynamic farmers with roots in agriculture, and foot loose farmers waiting for the 'opportunity' to leave agriculture. It is estimated that about 60% of the farmers are struck in agriculture, not because they have found agriculture 'profitable', but because they do not have alternative avenues for their livelihood. This implies failure to shift 'surplus' labour force from agriculture at least to rural non-farm sector by diversifying livelihood options.

- The low rate of poverty reduction from 3.1% per annum during 1983 and 1990/91 to 1% and less per annum during 1990s is another concern. Even in 1990s, there was a considerable decline in urban poverty, but rural poverty reduction rate was almost close to zero, and there are no signs of improvement in rural poverty reduction rates. Why productivity fatigue and technology fatigue and technology fatigue, and why impasse in growth performance of Indian agriculture? What are the search areas (drivers) for agricultural growth (Details in Bisaliah, 2009 c)? To place agriculture on high growth trajectory, there are many areas such as rebuilding natural resource base, augmenting rural human capital by improving its quality, energizing agricultural R & D domain, improvement in irrigation, markets, roads, adequate emphasis on non-price factors of agricultural growth in addition to price-interventions (setting the prices right), rural electrification development of non-farm sector and so on.

  All these growth promoting agents require investment in agriculture. But one of the most disquieting developments in the agricultural sector during the last decade

has been the neglect of capital formation in agriculture, especially in public sector (Details under section 5.3). What ever the research reports and policy documents one reviews, the development experience of Indian agriculture has been fall in public investment in agriculture giving rise to dismal productivity / production performance of Indian agriculture, falling TFP (Ranjita, 2005) and so on. The experience of China shows that high rate of investment in agriculture can ensure big spurt in agricultural output (Rao et.al 1994). Many of the problems of agriculture sector viz low productivity, low employment opportunities, high intensity of poverty, and inadequate infrastructure are attributed to inadequate and progressive decline in public investment in physical capital (irrigation rural electrification, roads, markets etc), human capital (health, education and training) and development of non-farm sector. These arguments are reinforced by a recent report by World Food Programme (2009) which recommends more public investment in agriculture, among others, to prevent further fall in agricultural productivity and to ensure a food-secured India.

5.2. **Concepts of and Data Base on Capital Formation**: **Three Bouts of Research**:

To analyze the impact of capital formation on agricultural growth, and of agricultural growth on poverty, there is a need for analyzing the trends and composition of capital formation in / for agriculture. Before that the concepts of data base on capital formation would be essential, because what should constitute capital formation has been one of the methodological controversies debated by researchers. The controversy has been further sharpened by the distinction which Dantawala (1986) has drawn between capital formation in and for agriculture.

The **first** major attempt has been by Shukla (1965) in her pioneering work on 'Capital Formation in Indian Agriculture during 1920-21 and 1960-61. The study was conducted at a time when there was no unanimity of opinion regarding the items to be included in the capital stock; of course this methodological issue is still alive. Starting with a broad definition of capital consisting of physical durable assets, the working capital and the resources invested in human capital, the study has confined to the definition of capital stock to include capital invested in land, capital in the form of housing, farm equipment

such as tractors, ploughs, carts, oil engines and electric pump sets for private irrigation, sugarcane crushers, work animals (only bullocks), and investment in irrigation. The definition has been constructed, in view of data availability on these assets in physical units, and on valuation problems for aggregation to arrive at total capital stock. In broad terms, the difference between land substituting capital like irrigation, and labour (human and bullock) substituting like tractors is still relevant, because the process of agricultural growth is the process of finding substitutes especially for scarce inputs. This is actually the theme of 'Induced Invocation' model of agricultural growth (Hayami et.al 1985). It is not out of place to state a few major conclusions of this study with data for a period of 40 years between 1920/21 and 1960/61, and Indian agriculture was yet to escape from the trap of low level of equilibrium. Perhaps some of the under developed / developing countries like Sub-Sahara Africa are still placed in this situation. First accumulation of the stock of capital has barely kept pace with the increasing labour supply. Following this, capital/labour and capital/output ratios were nearly constant during forty years of study. Lack of technological improvement over the period of study would imply a some what rigid relationship of complementarity between labour and capital (i,e almost constant capital/labour ratio) This theory leads to conclude that capital stock would rise with technological improvements in agriculture. Further constant capital/output ratio also represents lack of technological change. Second, lack of technological change and relationship of complementarity between capital and labour leads to the explanation why major portion of capital investment is devoted to traditional forms of capital when investment rate is low. Hence the only major 'route' to break the long-term low level of equilibrium of Indian agriculture was technological change in agriculture, which started occurring from the middle of 1960s in the form of mainly bio-chemical technology.

The **second** stream of research has been with the data compiled by Central Statistical organization (CSO) as a part of National Accounts Statistics (NAS) in accordance with the concepts and definitions in the System of National Accounts (SNA) of United Nations (Recommendations of SNA-1993 in Report of the Committee on Capital Formation in Agriculture, 2003 for enlarging the accounts of sub-sectors). CSO has compiled estimates of capital formation in agriculture with break-up of public and private investments as a part of NAS. CSO estimate of public sector investment includes investment in irrigation

schemes, and plantations in the forestry sector. Irrigation alone would account for more than 90% of the gross public capital accumulation in agriculture. In the scheme of estimation of capital formation considered are: assets created by construction like irrigation, machinery and equipment and change in stocks (inventories). Among others, one of the limitations of CSO estimate of household sector capital formation is that it does not take into account change in the stocks of supplies and materials and work in progress during the accounting year. All it does is to estimate the inventories relating to livestock. This implies that change in capital stock in household sector is under estimated (Mishra 1996). For this reason and may other reasons stated in the Report of the Committee on Capital formation in Agriculture (2003), the data set provided by CSO is termed as 'Narrow Data Series'.

Private sector investment includes investments made by farm households and private corporates. The household sector investment comprises investment on farm equipment, machinery, irrigation, land reclamation and land improvement. Household investment alone would account for over 90% share in private sector investment. The household data is developed, using the data generated by Reserve Bank of India under All India Debt and Investment surveys (AIDIS) conducted once in ten years.

The private corporate sector investment under construction includes expenditure on tea, coffee and rubber plantations. It also includes investments made by cooperative entities like Sugar and Milk Cooperatives.

Two concepts of capital formation used by CSO also need to be placed in the perspective of examining trends in capital formation in the next section. The concept of fixed capital formation refers to a set of assets produced as outputs from the process of production that are themselves used repeatedly or continuously in other process of production for more than one year. Fixed capital gets 'consumed' in the process of production. The extent of loss of its productive potential is known as 'consumption' of Fixed capital (CFC). Fixed capital formation computed without netting for CFC is known as Gross Fixed capital Formation (GFCF). The term gross capital Formation (GCF) refers to the sum of GFCF and change in inventories

In brief: GCF = GFCF + Δ Inventories

: NCF = GCF – CFC

Where NCF = Net capital formation.

The **third** bout of research is based mainly on what is called 'Broad Data Series' as against 'Narrow Data Series', provided by CSO. The main reason for developing the 'Broad Series' is to reexamine the issue of falling agriculture output due to falling / stagnant public investment in agriculture since 1980s as argued by researches using CSO data set (Rath 1989; Mitra 1996; Rao 1997 and many others), since these conclusions are based on CSO data base with its concept, coverage and estimation procedure. Further the reasons for falling public sector investment have been attributed to rising subsidies, growing opposition to big irrigation dams and so on (Rao 1997; Mitra 1996; Gulati et.al 1997; Dhawan 1998). All these methodological controversies have warranted research efforts for redefining the concept of capital formation in public sector and to re-estimate it.

The argument of Dantawala (198) to draw the distinction between capital formation in agriculture and capital formation for agriculture has provided the logical foundation for the third bout of research. To monitor agricultural growth and its drivers, it is necessary to have a broader measure of agricultural capital formation that includes capital formation in activities such as production of fertilizers and pesticides, development of agricultural markets, rural roads and communication, agricultural education, research and development of agricultural technology, rural electrification and so on which can be called capital formation for agriculture in comparison with capital formation in agriculture being complied by CSO as a part of National Accounts Statistics. Many significant attempts (Chand 200 and 2001; Roy 20014; Gulati et.al 2002; Report of the Committee on Capital Formation in Agriculture 2003) have been made to redefine the concept of public investment in/for agriculture and to develop 'Broad Data Series' relating to public investment as against 'Narrow Data Series' of CSO.

First, Chand (2000; 2001) using the data available in Financial Accounts of Union (Federal) and State (Regional) Governments for 23 years (1974/75 and 1996/97) has developed investment series called 'Broad Series' (Bisaliah 2004). This 'Broad Series'

cover capital expenditure in public sector under 23 heads, including the ones in CSO series and investment in fertilizer industry, rural roads and so on. Further, Chand (2000) has also developed time series data on private investment at State (Regional) level, using data generated once in ten years by Reserve Bank of India under All India Debt and Investment Surveys (AIDIS), data generated by National Sample Survey Organization (NSSO) under Household capital Expenditure, and the National Level private investment data compiled by CSO.

Second, Roy (2001) has broadened the ' Broad Data Series' on public investment by considering capital expenditure under 21 heads (including the ones in CSO 'Narrow Series'), and 50% of revenue expenditure on rural development, and agricultural research and education. He has also constructed time series national level data on private investment by using the CSO national level private investment data. Further, by using CSO data, generated by Reserve Bank of India under AIDIS, and by NSSO under household capital expenditure, he has also developed time series State level data on private investment.

Third, Gulati et.al (2002) have re-examined the major issues of declining public investment in 1980s, complementarity hypothesis and impact of capital formation on productivity growth, using three concepts of public investment, viz, Concept I as made available by CSO covering basically Government investment in irrigation schemes, and plantations in the forestry sector; Concept II comprising components of Concept I of CSO plus part of the investment in power sector that goes to agriculture, as reported by Central Electricity Authority / Planning Commission; Concept III comprising of components of Concept II plus investment in agriculture and allied sectors under 11 items of expenditure, as per budgetary classification under centrally sponsored schemes. However, the efforts made by Chand (2000, 2001) and by Roy (2001) and Gulati et.al (2002) in developing 'Broad Data Series' are mainly in relation to their personal research works, but not for the publication of 'Broad Data Series' on public sector investment in agriculture as a time series data set continuously.

The Report of the Committee on Capital Formation in Agriculture (2003) has further sharpened the data base for analyzing public investment for agriculture. The committee

has argued for broader investment series, keeping in view the difference between capital formation in/for agriculture. Information needs of agricultural development managers extend beyond farm production activity. They need information from sectors such as agriculture & allied, industry (agricultural machinery, fertilizers and pesticides), electricity and water supply, construction (irrigation structures, rural roads, agricultural markets etc), trade, railways / shipping / airways / roads, storage, communication, banking and insurance, capital expenditure on rural development, crop husbandry, soil and water conservation, preservation of wild life and environments and so on. We need three data series to construct broad data series for agricultural development managers:

First, capital formation for agriculture obtained by regrouping the CSO estimates. Second, capital formation for agriculture through investment in agricultural education, research and extension. Third, expenditure on conservation of forest (including wild life) and environment also qualify for inclusion as capital formation for agriculture. But all these would go beyond the confines of SNA. However any attempt to expand the data set for including expenditure on education as investment in human capital may also invite suggestions for including public expenditure on health, housing, as investment in human capital. Hence too much broadening of the capital formation will raise the methodological controversy of benefit gestation period, and apportion of expenditure towards consumption and production components for assessing the impact on agricultural growth. But data on these items under three data subsets may be of help for monitoring supportive and sustaining factors for agricultural development. The following rough and provisional estimate of proportion of expenditure to be allotted to agriculture suggested by this Committee (2003) may provide some insights into the role of different sectors in capital formation for agriculture:

Sl No.	Sector	Proportion of GFCF meant for agriculture
1	Agriculture & Allied	1.0
2	Agricultural Machinery	1.0
3	Fertilizers & Pesticides	0.96
4	Electricity / gas & water supply	0.09

5	Construction	0.09
6	Trade	0.25
7	Railways	0.07
8	Storage	0.69
9	Communication	0.09
10	Banking & Insurance	0.05

Added to this apportionment of proportion is the percentage share contribution of different sectors to GFC formation for agriculture during 2001-02 at 1993-94 prices.

Sl No.	**Sector**	**Percentage share in GFCF for agriculture**
1	Agriculture	68.95
2	Agricultural Machinery	0.86
3	Fertilizers & Pesticides	9.16
4	Electricity / gas & water supply	6.69
5	Construction	1.20
6	Trade	4.82
7	Railways	1.05
8	Storage	0.50
9	Communication	3.20
10	Banking & Insurance	0.42
11	Public administration and defence	3.15
	Total GFCF for agriculture	100.00

It is obvious that three sectors alone viz agriculture, fertilizers and pesticide industry, electricity. gas & water supply sector would form about 85% of capital formation for agriculture. Among other recommendations of this Committee, one important recommendation about data on capital formation needs serious condition. That is, the system of Economic Accounts for Food and Agriculture (SEAFA) designed by FAO may be adopted by the Ministry of Agriculture for

implementation. The major sources of data for SEAFA are Input Survey, Livestock Census, Agricultural Census and Livestock and Land Holding Survey conducted by National sample Survey Organization.

One more data set developed by FAO recently on Agricultural Capital Stock for 237 countries (including India) along with Region wise classification needs critical examination vis-à-vis agricultural capital stock data estimated by National Accounts system (NAS) of India and some other countries in accordance with the concepts and definitions in the system of National Accounts (SNA) of United Nations. This could be a separate study.

5.3. **Investment Behaviour In Indian Agriculture**:

The level as well as the growth rate of capital stock in agriculture, both in public and private sector (farm household sector), would depend on the investment behaviour of decision makers. Before the growth analysis of capital formation and the shifts in its composition, an analysis of investment behaviour of both the sectors focusing on determinants of investment is in order. Any policy / programme designs will have to depend on casual factors governing of investment behaviour of public and public sector. If agricultural sector is 'starved' of capital stock with its negative impact on agricultural growth which in turn adversely affects the rate of poverty reduction, an understanding of investment behaviour becomes crucial. Answer to the issues of falling public investment and the regime of incentives to which private sector would respond positively may have to be attempted through the study of investment behaviour. This section draws heavily from a study by Bisaliah (2004). Investment behaviour is a complex economic relationship which may not be amenable for dissection. Hence there is a large gap between theory of investment behaviour and the study of investment behaviour in developing countries (Gandhi, 1990, and 1996). In the absence of a strong relevant theoretical foundation to develop postulates, one may have to depend on empirical hunches. Hence there is still some room for empirical enquiry into the magnitudes and directions of movements under given conditions.

5.3.1. In macromodelling literature, investment in Indian agriculture has been considered in two ways (Dhawan et.al 1997): while a behavioural investment function is specified for private fixed farm investment, public investment is deemed to be exogenously determined.

Further behaviour of public investment is largely determined by agricultural problems and policies of the time (Details in Bisaliah 2004). An examination of public sector investment behaviour appears to have been dictated mainly by food situation of the country and agricultural policies governed by political economy of the time (Mishra 1996; Roy 2001; Gulati et.al 2002) It is possible to identify four broad epochs in this regard.

First, the food deficit after independence was strong enough to pilot more public investment towards the development of irrigation system.

Second, the food crisis of 1960s was compulsive enough to accelerate public investment in agriculture R & D, irrigation, and other rural infrastructure like roads, markets and so on. This really escalated public sector investment growth rate at a trend rate of about 8% per annum during 1970s (Details in the next section)

The **third,** epoch has been since 1980s when decline in public investment has been strongly voiced. The irony is that the success of Green Revolution itself has led to the emergence of some political economy compulsion which continues to persist. The emergence of 'surplus' produce in agriculture sector had given rise to the formation of politically powerful farmers groups, which have become rather powerful to 'dictate' priority setting for public expenditure in agriculture. The first priority has been to meet the demand for production subsidies to meet which Government budgetary resources have to be diverted from capital account to current account. The next important priority has been to finance private sector capital formation by institutional loans and capital subsidies.

The **fourth**, epoch is the one that has been in vogue since the dawn of economic reforms. Given the 'dictates' of economic reforms for 'setting the prices' by eliminating subsidies, and for encouraging private sector to crowd into increase its investment in agriculture and for the public policies to create an incentive regime for private investment, especially corporate investment, the prescription has been to effect reforms in agriculture sector. However, political economy compulsions, again appear to tone down the 'dictates' especially on subsides (Details later). Further a set of 'demands' such as to prevent declining TFP in agriculture, to focus on the development of dryland agriculture, to increase investment in agriculture R & D and extension to meet the challenges of

liberalized trade regime, to make investment for value addition to agriculture and horticulture products, and to increase investment in irrigation and renovation of water bodies are putting pressures on Government to increase its investment in agriculture as a part of 'non price interventions' for agriculture growth. With all these, the major empirical determinants of public investment are subsidies, opposition to major and medium irrigation systems by environment groups, interstate disputes on water sharing, and so on (Bathla et.al 2006 for details on determinants of public investment)

In the context of public investment in agriculture, determinants of public investment at State (Regional) level are equally important. The level and composition of public investment at Regional level are postulated to depend on rural literacy level, population growth State agriculture GDP, farm subsidies and grant-in-aid from Federal Government. An important Regional level study (Roy 2001) has concluded that rural literacy, population, agriculture GDP, and grant-in-aid from Federal Government have positive impact on public investment, whereas farm subsidies crowd out public investment as suggested by negative relationship between farm subsidies and public investment.

5.3.2. Modeling of private investment behaviour could be straight forward, if prospective profitability of investment (rate of return on investment) is known; but there are many uncertainties and risks. The yield and price risks and low-risk bearing ability of farmers would make the decision making by farmers on investment very complicated. Any study of farmers investment behaviour has to be undertaken in multivariate and simultaneous equation framework, with relevant price and non-price determinants as explanatory variables and with proper lag structure. For this reason, the modeling of private investment function has considered various explanatory variables such as price factors like terms of trade (Misra 1998; Mishra et.al 1996; Chand 2000) farm interest rate, farm wage rate (Gandhi 1996) and non-price factors like technology (Gandhi 1990, 1996; Mishra et.al 1996) institutional (Ex. institutional credit Gandhi 1996, Karmkar 1998; Chand 2000, land holdings size, tenancy etc), savings, infrastructural variables like rural roads and electrification by public sector, other public sector investment items like watershed development programme, irrigation works, regulated markets etc, value of agricultural output, private capital stock in the preceding year and rural savings (Gandhi, 1996).

Choice of explanatory variables to explain the variations in private investment and their measurement, and the choice of equations for estimation and data period would have bearing on the direction and magnitude of elasticity of private investment with respect to explanatory variables. Results from a couple of studies could illustrate the choice of methodology for identifying the determinants of private investment. Chand (2000) in his study of determinants of investment during 1980/81 and 1996/97 has concluded that terms of trade for agriculture and institutional credit to farmers have positive and significant impact on private capital formation at national level, but a study of regional level private investment behaviour has led to the inference that both public investment and institutional credit have exerted a positive significant impact on private capital formation in agriculture. In yet another study by Chand et.al (2004), rate of return to private investment (which in turn depends on terms of trade and technology) is found to be the most important determinant of private capital formation. The second most important determinant of private investment is the addition of new farm holdings. Institutional credit and subsidies are found to have positive impact on private capital formation. There is asymmetry in the impact of increasing and decreasing public investment on private investment. An increase in public investment definitely impacts positively private investment, while decline in public investment forces farmers to cope with the adverse impact of decreased public investment by increasing private investment. This kind of asymmetry needs to be interpreted carefully, because the composition of public and private investment would not be the same, excepting perhaps in case of irrigation.

Roy (2001), in a major study using data of 17 States from 1970/71 to 1988/99, and estimates made with simultaneous equation model, has attempted to explain variations in private investment in agriculture. This study has identified public investment (as per Broad Data series), terms of trade, rural road density, and subsidy as the major determinants of private investment with positive impact. The positive impact of subsidy on private investment runs against the well-articulated stand that a agricultural subsidies are 'bad' (Details later), and subsidies would reduce public investment. However, it is difficult to be conclusive that positive gain in private investment due to subsidy would compensate the 'loss' due to decreased public investment. The incidence of rural poverty is also found to have negative impact on private capital

formation. Further, the negative and significant impact of percentage area under marginal holdings is suggestive of land holding size constraint on investment in farm assets, and it is also suggestive of the need for more public investment in agriculture to support and sustain the viability of marginal holdings.

Another approach (Gulati et.al 2002) to identification of determinants of private investment is to measure public investment in both physical and monetary terms with appropriate lags to find out the impact, institutional credit and index of terms of trade (lag one year). Performing the analysis in a multiple regression framework with data for the years 1980/81 and 1998/99, Gulati et.al (2002) have inferred that public sector investment in agriculture (measured in terms of canal irrigation and power supplies to agriculture in cumulative form), terms of trade and institutional credit have positive influence (inducement effect) on private investment. It is also argued that any neglect of these variables in Government investment programmes would have an adverse impact ton private sector investment and growth.

It is obvious from the discussion preceded that studies on determinants of private investment have been conducted using data for different periods of time, using CSO data set and broad data series, using state level and national level data, and with different estimation procedures. Hence studies have identified different determinants of private investment, but also have indicated varying importance of same determinants in influencing private investment. The signs and sites of the coefficients of determinants appear to hinge on period of study, choice and measurement of variables, and the choice of estimation procedure. Most of the studies have concluded that public investment is an important determinant of private investment (call it as complementary effect or inducement effect). However, the magnitude of the influence of public investment on private investment may vary depending on model specification, period of study, stage of technological and agricultural development, and policy environment. Further, there is some validity in the argument that if public investment is measured with broad data series, and if appropriate lags are incorporated (to account for response of private investment to public investment), then public investment tends to have a strong impact on private investment. The issue of which public investments would

induce more private investment, which ones reduce private investment, and which of private investment are unaffected by public investment is still a matter of further research, and the results of which will be quite valuable in policy making on public investment resource allocation. Hence the topic of the impact of public investment on private investment is still debated, and the forms the theme for discussion under section 5.5.

One could also analyze the determinants of aggregate capital formation in / for agriculture ignoring the difference between public and private investment. In the aggregative analysis, it is possible to postulate that Agriculture GDP, public investment and private investment terms of trade, subsidy, rural literacy level (a proxy for human capital), share of marginal holdings, population growth, institutional credit, modern input use (high yielding varieties, chemical fertilizers etc), density of rural roads and markets, irrigation intensity and so on will have impact on capital formation. In brief, socio-economic, political, institutional, infrastructural, technological and agro-ecological variables could be postulated to impact capital formation.

5.4. **Capital Formation: Growth and Compositional Shifts**:

A detailed study has been conducted by Bisaliah (2004) on the theme of growth and compositional shifts of capital formation in agriculture. Hence some highlights of that study are recapitulated to provide the backdrop for the present section.

5.4.1. The earlier study has identified the investment growth cycle (i,e, the period of growth and deceleration in capital formation in agriculture). The growth cycle (analyzed with CSO data series) encompasses rising trend during 1960s, relatively subdued phase during the first half of 1970s, momentum of peak phase during second half of eighties, and a decline there after. Investment growth cycle has been analyzed from different angles like growth rate trends in Agriculture GFCF (AGFCF) vis-à-vis aggregate GFCF, shifting shares of GFCF and AGFCF in GDP, shifting share of AGFCF in Agriculture GDP (AGDP), and trends in the annual growth rates of public and private investment in agriculture in relation to trends in overall investment growth.

Recapitulating some broad results.

- The investment growth cycle encompasses rising trend, subdued phase, peak phase, persistent deceleration, and margin recovery.
- The annual growth rates of aggregate GFCF are found to have increased between 1960s and 1990s, whereas AGFCF had suffered deceleration during the same period.
- The share of aggregate GFCF as a percent of GDP had increased between 1960s and 1990s, where as AGFCF as a percent of GDP had declined.
- The percentage of AGFCF in total GFCF had halved between 1960s and 1990s.
- The percentage share of AGFCF in AGDP was lower in 1990s than in 1970s or 1980s.

  All these would imply, in broad terms, a loss of momentum in capital formation in Indian agriculture in 1980sa well as 1990s, with implication for agriculture growth and poverty reduction (Details later).

5.4.2. The study by Bisaliah (2004) has also analyzed compositional shifts in capital formation in agriculture from two angles viz public sector vis-à-vis private capital formation and farm household investment. The major findings are detailed as below:

- The percentage share of public sector in GCF in agriculture declined from 51% in 1980-81 to 24% in 2002-03, whereas the percentage share of private sector increased from about 49% to 76% during the same period. Further, the compound growth rates of public sector investment declined from 9.5% in 1970s to -3.89% in 1980s and to 0.11 in 1990s (indicating some marginal recovery). During the same decade, the compound growth rate of private sector investment declined from 7.81% in 1970s to 2.62% in 1980s and to 3.73% in 1990s (indicating some marginal recovery). These results are again suggestive of loss of momentum in capital formation, and much more in public sector. Since the most important item

of capital expenditure under public sector is irrigation, decline in public expenditure would mean decline in investment in irrigation.

- Out of the total investment in agriculture and allied sectors, the share of agriculture alone would come to over 90%.

- With respect to composition of farm household investment, agricultural implements, machinery and equipment and well / other irrigation structure alone would account for over 70% of capital expenditure incurred by household sector in agriculture. The other items of capital expenditure incurred by farm households are land improvement, farm houses and animal sheds, and orchards and plantations (Gulati et.al 2002). This analysis of investment port folio of farm households with respect to agriculture would provide insights into one important dimension of their credit propensity viz propensity to borrow for specific purposes.

5.4.3. **Some Recent Trends in Investment Growth and compositional shifts**:

An examination of recent trends in agricultural investment and the compositional shifts would add to our understanding of investment growth cycle vis-à-vis earlier trends. While doing this analysis, one has to keep in view the methodological issue surrounding whether one should use the measure of GCF or GFCF. One view is that one has to look at GFCF rather than GCF, because of the fluctuations in the stocks (Alagh 1994; 1997, Mishra et.al 1995): Counter to this view is that the trends in public sector GFCG would similar to those of GCF with minor differences (DEV 1997). An examination of trends in the percentage share in agriculture (Table 5.1) suggests that the share of public and private sector was almost the same during 1960s and 1980s; but the share of private sector increased to 72% and that of public sector decreased to 28% between 2000-01 and 2003-04, the share of private sector was almost 80%, and of late there has been a marginal increase in the share of public sector (24% in 2005-06).

Yet another way is to examine the percentage share of agriculture and allied sectors in National GDP (Table 5.2). It is obvious from these results that the percentage share of the sector has been 2.3 between 2002-03 and 2006-07, with a marginal decline in the share of private sector. However, the over whelming dominance of private sector

stands out. Added to this one could also analyze the GFCF in / for agriculture as a percentage of National GDP. It could be observed from the results of Table 5.2A that compared to 1980-81, the total share of the sector has been on the decline till the beginning of the present decade. Further the decline is found to be much more evident in case of GFCF share (%) in agriculture than for agriculture; but in both the cases, the share of GFCF in national GDP has halved between 1980-81 and 2001-02.

How are the trends in the percentage share of GCF in agriculture and allied sectors in the GDP originating in this sector? If could be observed from Table 5.3 that starting with about 11% in 1999-2000, the share is found to have increased to about 14% in 2007-08. The issue could also be examined with broad trends in percentage share of GCF in/for agriculture in Agriculture GDP between 1980s and 1990s (Table 5.4) Two observations could be made on these results. First, the percentage share of GCF for agriculture in AGDP was higher than that of GCF in agriculture. This justifies the need for considering 'Broad Data' series for investment analysis. Second compared to 1981-83 average percentage share of total AGCF in AGDP, the percentage share is found to have declined during two decades. This reinforces the earlier argument of loss of momentum in agricultural capital formation.

What have been the trends in the percentage share of Agriculture and Allied sectors in Total GCF? As could be seen from table 5.5 that the share of agriculture and allied sectors declined from 23.5% in 1952-53 to between 20% to 14% during 1953/54 and 1983/84, to 9.9% in 1990/91 to 6.2% in 1995/96 and to 9.0% in 2002-03. With all the marginal recovery during the recent years, the share of agriculture and allied sectors in total GCF has been on the decline during the last 50 years in India. One more approach to examine this issue is to discuss the trends in the percentage share of public sector and private sector in the total share of agriculture and allied sectors in total GCF for the economy (Table 5.6) during the last 15 years or so. It is also obvious from these results that the percentage share of the sector has been declining all along, even though there has been a decline in the share of private sector in total GCF of the economy and some increase in the share of public sector. Further the GFCF for the economy out of

national GDP had increased from about 23% in1980-81 to 26% in 2001-02, whereas the share of agriculture had decreased from 7.7% to 3.9% (Datt, R 2006)

5.4.4. Data generated by Report of the committee on capital Formation in Agriculture (2003) could also be analyzed to find out the shifting contribution of 10 specific sectors to GFCF for agriculture during 1991-92 and 2001-02 (Table 5.7). In the framework of 'Broad Data Series' also, the capital expenditure under Agriculture and Allied sector continued to be over two third of total capital expenditure under 11 heads, followed by other heads like fertilizers or pesticides, trade, communication and so on. Further, the share of heads like agriculture machinery, fertilizer and pesticides, communication had experienced considerable increase, whereas the heads like electricity gas and water supply and banking and insurance have registered considerable decline.

5.4.5. It is also appropriate to analyze the trend growth rates in capital stock, technology, electricity use, gross irrigated area, and cropping intensity in agriculture (Table 5.8). The analysis of trends in growth rates for about a quarter century would provide broad insights into investment in agriculture, development of technology, gross irrigated area, electricity use in agriculture, and cropping intensity which have a strong bearing on agricultural productivity and output growth. It could be seen from these results that the growth rates of total fixed capital stock in agriculture had declined from 2% to 1.28% between period 1 and period 3. This has been mainly due to decline in rate of growth of public sector net fixed capital stock from 3.86% per annum to 1.42% during these two periods, and partly due to decline in the rate of growth of private sector net fixed capital stock from 2.17% to 1.17% between period 2 and period 3. Coupled with this growth rate deceleration in capital stock in agriculture have been decelerations in the growth rates of technology development (agricultural productivity as a proxy), irrigation, electricity use, and cropping intensity-all proximate causes, of agricultural growth. All these decelerated growth rates tend to impact adversely growth performance of agriculture and tempo of poverty reduction (Details later).

5.4.6. It is realized that it is not enough to analyze only the trends in the level of investment in agriculture, but it is equally important to assess the efficiency of investment made Excessive pre occupation with capital formation has prevented from looking at the

efficiency of capital use in India agriculture (Mishra et.al 1995). Efficiency of investment is usually assessed by Incremental Capital Output. Ratio (ICOR), and the inverse of that being Marginal Efficiency of Investment (MEI). ICOR is not a perfect measure of efficiency, yet it is useful (Rao, et.al 2000 and Hirashima 2000). ICOR is both a measure of capital intensity and a measure of efficiency in its use. It is also a useful device for determining sectoral as well as regional allocation of capital resources, and also to estimate the level of investment required to achieve a targeted rate fo output growth and there by the total output growth. Further, it could also be used for deriving output growth rate, once capital resource position is known. A review of estimates (Bisaliah 2004) made by Misra et.al (1996), Chand (2000), Roy (2001) and Gulati et.al (2002) suggests variations (Details in Bisaliah 2004) across estimates derived, could be attributed to choice of time period, base year, and the choice of time lag used (Roy 2001 for determination of time lag) for determining the flow of capital services. Misra et.al (1996) have observed that improved efficiency in capital use (decreased in ICOR) in 1980s was partly due to increased private investment during late 1980s, and also to increased use of yield-increasing inputs and improved market support.

- A broad conclusion from the study of Chand (2000) is that there has been an improvement in capital use efficiency in India agriculture since 1980s. Roy (2001) attributes the improved efficiency in capital use to impressive agricultural output growth and increased flow of services from capital investments made on major irrigation projects. The study by Gulati et.al (2002) has concluded there was an improvement in capital use efficiency in Indian agriculture between Fourth Five Year plan period (1969-74) and Eight Five Year Plan (1992-97). With these estimates, there appears to be an improvement in the efficiency of capital use in Indian agriculture, even though much is desired with respect of management of public sector capital assets. Added to all these is the argument (Roy 2001) that planning commission, Government of India, has been using much lower ICOR in sectoral allocation of investment resources for agriculture, leading to under estimation of needed capital investment to achieve a given targeted output growth rate. Further, given the variations in ICOR across States (Regions) in the Country,

well defined norms needs to be determined in the allocation of resources from the Central (Federal) Government to State Governments.

5.4.7. What could be the broad substantive conclusions of the section 5.4? First, capital formation in agriculture as a proportion of total GDP and total capital formation in the economy and in terms of capital stock growth rates in agriculture since 1980s, has experienced deceleration. This has been mainly due to fall in public investment in agriculture. Although some increase in private investment has been recorded, as discussed already public and private investment cannot be treated as substitutes. Their compositions are different. For example, public investment is mainly in medium and major irrigation work, while private investment is mainly in minor irrigation mechanization and land development (Sawant et.al 2002). Second, apart from difference in composition, public investment affects directly growth performance of agriculture sector, and indirectly through its inducement effect on private sector investment. Third, agriculture is basically a private activity, public investment has a critical role to play in creating the infrastructure in terms of irrigation, roads markets, storage facilities, rural electrification and technology development, besides rural health and education (Thamarajakshi, 1999). Fourth, both public and private investment in agriculture and agri-business are crucial, but both have remained weak since the early 1990s, despite accelerating growth in the overall economy and a large domestic market for agricultural products; Growth in farm output has slowed down since the early 1990s, mainly due to inadequate infrastructure for the sector (Thorat et.al 2003; USDA 2008) If has been very well articulated (Blarcom et.al 1993; Selvaraj 1993; Alagh 1997) that the level of public investment (meant for infrastructural development for augmenting productivity capacity in the agricultural sector) is crucial for growth of agricultural output and for addressing other items of development policy agenda like unemployment and poverty. Further this decline in public investment in agriculture with its adverse impact on growth performance of this sector would contribute for economy wise slowdown (Chand 2003) through supply and demand routes and lower development multiplier. The crucial role of public investment for development of infrastructure to support agriculture is very well recognised. But what is needed is to review of policies which have led to the diversion of scarce resources away from the creation of productive assets, by better targeting of subsidies. Because, during

the past two decades, Government expenditure control (to ensure fiscal discipline as part of Economic reforms Agenda) have led to cut back on agricultural investment, but not on subsidies especially on fertilizer, power and irrigation water.

Table 5.1: Percentage share of Public and Private Investment in Agriculture

Period	**Public Sector**	**Private Sector**
---------- At 1993-94 Prices ----------		
1960s	43	57
1980s	45	55
1990s	28	72
---------- At 1999-00 Prices ----------		
2000-01	18.5	81.5
2001-02	18.6	81.4
2002-03	17.0	83.0
2003-04	20.8	79.2
2004-05	21.1	78.9
2005-06	24.2	75.8

Sources: Golait (2008) and Economic Survey: 2007, Government of India.

Table 5.2: Percentage share of Public and Private Investment in Agriculture and Allied Sectors in National GDP: At 1999-2000 prices.

Year	**% Share of**		**Total**
	Public Sector	***Private Sector***	
2002-03	0.4	2.1	2.5
2003-04	0.4	1.8	2.1
2004-05	-	-	-
2005-06	0.6	1.7	2.3

2006-07	0.6	1.7	2.3
2002-03 to 2006-07	0.5	1.8	2.3

Source: Central Statistical Organisation, New Delhi.

Table 5.2A: GFCF in / for Agriculture as percentage of National GDP: At 1993-94 prices

Year	In Agriculture	For Agriculture	Total
1980/81	3.4	4.3	7.7
1990/91	2.3	3.1	5.4
2000-01	1.5	2.3	3.8
2001-02	1.6	2.3	3.9

Source: Datt, R (2006)

Table 5.3: Percentage share of GCF in Agriculture and Allied sectors in GDP in the A & A sectors: At 1999-00 prices

Year	% Share
1999-2000	11.2
2000-01	10.20
2001-02	12.00
2002-03	12.68
2003-04	11.09
2004-05	11.98
2005-06	12.93
2006-07	13.15
2007-08	13.88

Source: Central Statistical organization, New Delhi

Table 5.4: Percentage share of GCF in / for Agriculture in Agriculture GDP

Period	GCF in Agri	GCF for Agri	Total
1983-83 Avg	8.3	10.7	19.0
1991-93 Avg	6.8	9.5	16.3
1996-98 Avg	6.4	9.4	15.8
1998-00 Avg	6.1	9.1	15.3

Source: Directorate of Economics and Statistics (2003), Government of India.

Table 5.5: Percentage Share of Agriculture and Allied Sector in National GCF

Period	% Share
1952-53	23.5
1953-1983/84	20% to 14%
1990-91	9.9
1995-96	6.2
2000-01	7.6
2000-02	8.1
2002-03	9.0

Table 5.6: Percentage share of Agriculture and Allied sectors in National GCF: 1999-2000 prices

Year	% Share of		Total
	Public Sector	***Private Sector***	
1999-00	6.0	11.9	10.2
2000-01	5.8	11.3	9.7
2001-02	6.7	13.7	11.7
2002-03	6.5	11.5	10.3
2003-04	7.4	9.2	8.8

2004-05	7.8	7.7	7.7
2005-06	7.9	7.1	7.2
2006-04	8.2	6.6	7.0

Table 5.7: Percentage Contribution of Heads of Capital Expenditure for GFCF for Agriculture: At 1993-94 prices.

Heads	1991-92	2001-02
1. Agri and Allied sectors	69.8	69.0
2. Agri Machinery	0.5	0.9
3. Fertilisers and Pesticides	5.0	9.2
4. Elect-gas and water supply	9.2	6.7
5. Construction	0.8	1.2
6. Trade	4.5	4.8
7. Railways	1.2	1.00
8. Storage	0.2	0.5
9. Communication	1.8	3.2
10. Banking & Insurance	1.4	0.4
11. Others	5.6	3.1
Total	100.00	100.00

Table 5.8: Trend Growth Rates in Net Fixed capital stock, Technology, Electricity use, Gross irrigated area, and cropping intensity in agriculture: 1980/81 to 2005/06

Item	1980/81 to 1990/91	1990/91 to 1996/97	1996/97 to 2005/06
Public sector net fixed capital stock	3.86	1.92	1.42 ✷
Private sector net fixed capital stock	0.56	2.17	1.17 ✷
Total net fixed capital stock	2.00	2.06	1.28 ✷
Technology	3.3	2.81	0.00
Gross irrigated area	2.28	2.62	0.51 ✷
Electricity use in Agriculture	14.07	9.44	-0.53 ✷ ✷
Cropping Intensity	0.51	0.39	0.12

Sources: Dev (2008) and Kapila, U (2009)

✷ upto 2003-04

✷✷ upto 2004-05

6.0. Debate on Complementarity between Public and Private Investment in Agriculture

This section is almost a reproduction of the analysis performed by Bisaliah (2004), excepting same deletions and additions.

It is recalled from earlier sections that all India trend analysis of public and private capital formation indicates the movement of both investment series in the same direction between 1960s and mid 1980s, and a divergent movement of these series since mid 1980s with public sector investment falling and that of private sector rising steadily. This decline in the momentum of public sector investment was considered as a disquieting development in India. Further public investment is one of the major determinants of private investment,. And any neglect of public investment in resource allocation by both central

and State Governments would adversely affect agricultural growth and policy concerns like poverty alleviation. However, the relationship between public and private sector investment has become a matter of great debate with its implications for policy directions so as to influence capital formation in Indian agriculture. The argument has been sharpened by the studies by Rath (1989); Shetty (1990); Gandhi (1990 & 1996); Rao (1994 and 1997) and Dhawan (1996 and 1998); Storm (1993); Mitra (1996); Misra and Hazell (1996 and 1998); Mishra et.al (1995); Chand (2000), Roy (2001); Gulati et.al (2002) and Chand et.al (2004). An examination of these studies would lead to five major inferences.

- There is a crowding in or positive inducement effect of public investment on private investment due to strong complementarity between public and private investment.
- There is only weak complementarity between these two types of investment.
- There is a strong relationship between two types of investment at micro level like canal-irrigated areas. Complementarity at macro level may not show up due to aggregation problem of treating all public investments alike with respect to impact.
- There is no apparent complementarity. Private investment may be partly induced by public investment and partly autonomous.
- State (Regional) level analysis of trends and **proper** definition and measurement of public investment variables support a strong case for complementarity both at national and State level.

6.1. Given these inferences drawn by different researchers, the estimated elasticities of private investment with respect to public investment have turned out to be different. For example, in some earlier studies the value of elasticity coefficient is found to be 0.62 in a study by Chakravarthy (1987) for the period 1970/71 to 1982/83, 0.66 in a study by Shetty (1990) for the period 1960/61 to 1986/87, 0.66 by Storm (1993), 0.25 by Dhawan (January-June, 1996) with respect to canal irrigation ratio (treated as a proxy for public investment), -0.50 by Mishra et.al (1995), 1.55 for the period 1960-70, 0.69 for the period 1970-80 and –0.31 for the period 1980-90 by Misra. et.al Hazell (1996), and 0.50 Saibaba (1996).

Differences in inferences derived on complementarity between public and private investment and in the estimated elasticities of private investment with respect to public investment could be attributed to many reasons such as different data sets used, data period, failure to see differences between instantaneous and cumulative effects of public investment on private investment, different lag structures used to find out the response of private sector investment to public sector investment, use of different terminologies such as complementarity, inducement effect and crowding in/out effects, failure to include relevant variables to assess the net effect of public investment, failure to recognize lagged response from farmers and lagged impact of public investment, failure to differentiate between movement of trend series and causal relationships, use of physical and financial variables, different evidences from macro and micro level studies, and treating public investment in irrigation on par with other variables like investment in roads.

6.2. With all the differences in inferences derived and elasticities estimated, the debate has been quite useful to understand and unearth the complexities of relationship between public and private investment. A brief presentation of methodologies and results of a few studies would illustrate the nature of the controversy and complexity in confirming or rejecting complementarity hypothesis.

6.2.1. Based on increasing trend in the CSO estimates of both private and public investment in Indian agriculture till 1980/81, there are many studies, which have confirmed the proposition on complementarity. The studies by Rath (1989), Shetty (1990), Storm (1993), Rao (1994 and 1997), Gandhi (1990; 1996), Dhawan (1996; 1998) have confirmed complementarity between public and private investment. Arguments of some of these studies could be placed in the proper perspective. Rao (1994; 997), while confirming the complementarity proposition, has argued that if public investment made in agriculture are properly accounted for including the excluded items like rural electrification, rural roads, storage, etc, the complementarity between public and private investments stands out prominently. Dhawan (1996; 1998), another supporter of complementarity proposition, has treated public canal irrigation intensity as a relevant explanatory variable instead of total public investment in agriculture for explaining variations in private

investment. The rationale is that public canal irrigation accounts for a major share of total public investment in agriculture. Hence the positive and significant impact of canal irrigation intensity on private investment both with macro and micro level data establishes the veracity of complementarity hypothesis. Infact macro and micro level evidences are found to lend support the complementarity proposition that public sector investment in canal irrigation stimulates private investment, including private means of irrigation.

6.2.2. The distinct trends have been observed with CSO data upto the end of 1980's. First the movement of investment series of both public and private sector till 1990/81 has led to the emergence of complementarity proposition. Second, after 1980/81 both the series started moving in opposite direction (declining trend in public sector investment, but continuous increase in private investment). This movement of both the investment series in the opposite direction has been the basis for questioning the validity of complementarity hypothesis by Chand et.al (1995). Yet another line of argument has been that though aggregate series of public and private investment do not support the complementarity hypothesis, project specific public sector investment, especially in irrigation, induced the investment in agriculture on private account (Mitra, 1996). This **partial** acceptance of complementarity proposition gives credence to the argument that complementarity hypothesis should be tested at the level of investment projects, and could be more prominent in the **construction** of assets like irrigation.

6.2.3. A redefinition and re-estimation of public investment in agriculture (broad investment series) has led to conflicting/confirming inferences on complementarity issue. For example, Chand (2000) has found negative and non-significant impact of public sector investment on private investment. This result is suggestive of lack of complementarity. But Chand (2000), using State level cross section study for the year 1981/82 to 1991/92, has led to the inference that broad public investment series bears a

positive and significant impact on private investment in 1981/82, and positive but insignificant impact in 1991/992. So his State level study with broad investment series suggests the conclusion that there is a partial complementarity depending on the type of public investment in different regional settings. Yet in a recent study by Chand et al (2004), it has been established that there is asymmetry in the impact of public investment on private investment. An increase in public investment is found to have positive impact on private investment, but a decline in public investment is found to have increased private investment as a part of coping strategies of private investors.

6.2.4. Redefinition and re-estimation of public investment data to derive broad investment series, and appropriate measurement of investment components, appropriate lags incorporated (to account for response of private investment to public investment), and the modelling of relationship between public and private sector investment in a simultaneous equation framework may lead to different conclusion. Roy (2001), using this methodological structure has derived the inference that public investment has a strong impact on private investment, and there is a strong case for complementarity proposition at national and State level.

It is recalled from earlier section that irrigation accounts for more than 90 per cent of public sector investment in agriculture. Further, public sector investment in power sector is required for pumping water. But these items of capital expenditures have a long gestation period of public investment in these two sectors. Hence, it is not rationale to visualize a strong complementarity. Further, the farmers' response to public sector investment in irrigation and power supplies cannot be instantaneous, and it is likely to be stretched over years. Hence expecting strict complementarity in such a situation is not warranted. There are two options to measure public sector investment in these two areas for testing complementarity hypothesis. First, one could use quantity of water and power supplied to agriculture each year. But it is difficult to get data on

water supplied each year under canal irrigation system. Second, in the absence of easy availability of data on water supplied each year, one could use cumulative potential created as a proxy variable for the total water supplied. Hence, it is rational to use physical quantity of power supplied to agriculture each year, and cumulative potential of canal irrigation created, and the annual expenditure incurred in public sector under 11 heads (Gulati et.al 2002) to test the impact of public investment on private investment in agriculture. Measurement of cumulative investment in canal irrigation could be both in physical and financial terms. Gulati et.al (2002) have performed this kind of analysis, using data from 1980/81 to1998/99, and concluded that it is hard to reconcile with the argument of no inducement effect or weak complementarity between public and private investments as stated by Chand (2000) and others. The analysis performed by Gulati et.al (2002) has led to the inference that there is a significant positive impact of public investment (if properly measured and lagged) on private investment, whether the public investment is measured in physical or financial terms.

6.2.5. Summing the results on complementarity hypothesis, there appears to be more evidence to confirm the complementarity hypothesis without ignoring other determinants of private investment. However, the magnitude of elasticity of private investment with public investment is bound to vary with the period of study, choice of variables on public sector investment and their measurement, construction of appropriate lags to impact and to respond, and specification of structural equations.

While arguing with narrow data set that private sector investment may increase even under the situation of declining public sector investment, one has to keep in view the compositional differences as between public and private sector investment, and the difference in their investment objective function. Public sector investment portfolio is expected to be a part of broader development agenda like equity, conservation of environment, and poverty alleviation, enhancing competitive capacity of Indian agriculture both in domestic and international markets, and the like. The enabling

investments in rural link roads, big irrigation projects, rural power supply, storage structures and market yards may have to be handled under public sector investment to induce private sector investment. Any entry of corporate sector to these lines of investment to induce farm household sector investment may be unimaginable for the time being, and certain types of public sector investments are necessary even to induce corporate sector to invest for agriculture. Hence, the challenge is to identify the sectors/areas where public sector investment is likely to have strong complementarity, weak complementarity, and where there is lack of complementarity, so as to decide public investment portfolio. Hence from the viewpoint of long term agricultural growth, lack of complementarity or weak complementarity should not under-estimate the importance of public sector investment. The challenge lies in identifying **right** priorities for public investment by keeping in view the varying priorities depending on stage of agricultural growth/development, broader development agenda, and more inducement effect on private farm household and private corporate sector investment.

Yet one more methodological issue relating to the analysis of time series data needs examination. Modeling of complementarity in a single equation OLS frame work may give rise to spurious relationship between public and private investment, if the assumption of stationarity of series is violated (Granger et.al 1974amd 1977; Nelson et.al 1982; Maddala 1992; Murray et.al 2000). To test the time series data on public and private investment for their stationarity, Augmented Dicky Fuller Test (ADF) can be applied. Once the results show that raw time series data is not stationary, use of co-integration technique to establish the relationship between public and private investment is appropriate. This what is called two-step procedure in estimation (Engle et.al 1987). But most of the studies (Dhawan et.al 1995; 1996; 1997, Mitra 1997; Rath 1989; Rao 1997 and many others) have used raw time series data to test the existence of complementarity or otherwise.

7.0. **Capital Formation, Agriculture Growth And Poverty Alleviation**:

This section is concerned with the assessment of relationship between capital formation and agriculture growth and poverty alleviation in India. A recall of some of the major conclusions / inferences from the preceding sections is in order, as that would provide a logical farmer work for analyzing the experience of India.

First, a search for sources of growth both in theoretical and empirical studies has led to the inference that capital (in a broad sense) is one of the major critical drivers of growth.

Second, growth accounting through growth regression studies has concluded that capital is a crucial input for 'catch up' in growth path and growth convergence. Added to this is the premise that 'idea gap' persists between countries leading to growth divergence, in the absence of adequate amount of capital accumulations.

Third, developing countries are to realize that capital accumulation is an escape from the vicious circle of poverty. One of the elements of pro-growth is productivity augmentation of labour force in developing countries by providing more capital to work with (i,e capital deepening) in agricultural sector, since poverty is dominantly a rural phenomenon.

Fourth, an analysis of growth-poverty nexus is suggestive of the inference that faster economic growth is only one avenue for reducing poverty. But growth maximizing development policy may not always lead to maximization of poverty reduction. Instead it is growth pattern and Sectoral composition of aggregate output which would contribute for a higher rate of poverty reduction. Hence the need for directing growth efforts to areas (rural areas), sectors (agriculture) in which poor people work, to the factors of production they possess, and to the products they consume. All these would suggest the need for growth of agriculture and rural sector.

Fifth, cross-country experiences on agricultural growth and poverty reduction have led to the inference that labour productivity and TFP together could impact poverty reduction. The determinants of TFP are irrigation, Government expenditure on agriculture, rural infrastructure, human capital, agriculture R & D and so on. Further, investment for the development of non-farm sector in rural areas would be equally important for increasing

and diversifying employment and income opportunities for the poor in the developing world. Hence capital (in the broader sense) is one of the major drivers of agricultural growth and poverty reduction through augmentation of labour productivity and TFP in agriculture.

Sixth, studies by Stephan (2009) and Schmidhuber (2009) have established the relationship between Agricultural Capital Stock (ACS), productivity of labour engaged in agriculture and hunger in developing countries. It is found that low ACS per worker, low labour productivity and high prevalence of undernourished 'co-exist'.

Seventh, given a limited amount of investment resources in developing countries, the development merit of a sector is to be judged by how much the sector would contribute for addressing the development problems like poverty, unemployment and inequalities, and how much of development multiplier it would give rise to through inducement effects. Agriculture emerges as a deserving candidate on both the counts of merit.

Eight, with respect to India experience there has been a loss of momentum in capital formation in agriculture in 1980s as well as 1990s with implication for agriculture growth and poverty reduction. Capital formation in agriculture as a proportion of total GDP and total capital formation in the economy and in terms of capital stock growth rates in agriculture since 1980s has experienced deceleration. This has been mainly due to fall in public investment in agriculture with implications for agricultural growth and poverty reduction. During 1980/81-1990/91 and 1996/97-2005/06, the country is found to have experienced fall in growth rates of net fixed capital stock in agriculture, stagnation of technology development, fall in growth rates of gross irrigated area, negative growth rate in electricity use in agriculture, and fall in growth rate of cropping intensity. All these proximate drivers of agricultural productivity and production growth would obviously tend to decelerated growth in India agriculture.

7.2. **Agriculture: Bypassed sector in High Growth Trajectory**:

India economy has entered the high growth trajectory during the last two decades or so, deserved to be labeled as one of the fastest growing economies of the world. But it is yet to address the problems of 'exclusive growth', leading to bypassing of some regions, some

sectors like agriculture and some segments of the society like rural society in the move towards high growth trajectory. The consequence of exclusive growth instead of inclusive growth is reflected in the persistence of poverty, unemployment and too much of development distance. It has been argued in the earlier sections that agriculture is a pro-poor growth sector, but there has been a deceleration in its growth performance reaching less than two percent growth rate of AGDP. Further, between 1996/97-2004/05, the growth rate of cereals (a major staple food item) was 0.02% Per capita food grains production per annum declined from over 200 kgs to 186 kgs (Dev 2008). Growth rate of land productivity of food grains declined from 2.12% between 1985/86 and 1990/91 to 0.52% between 2001/02 and 2005/06. This decline in productivity of land is attributed to decrease in input use and inadequate investment in public infrastructure, among others (Sen et.al 2004). Hence many of the problems of agriculture sector viz low productivity, low employment opportunities, low infrastructure (including irrigation), and high intensity of poverty are attributed to progressive decline in capital formation (Thorat 2003; Majumdar 2006; Bhatia 1999; Chadha 2003)

The experience of China shows that high rate of investment in agriculture can ensure big spurt in agricultural output and thereby poverty reduction. Fan et.al (2000; 2002) have recognized the returns of agricultural public investment in poverty reduction in China and India. There are evidences to suggest that Government development expenditure has positive impact on reducing poverty in India (Sen, 1996 and Datt et.al 1995)

All these evidences are suggestive of the nexus between capital formation, agriculture output growth and poverty. Added to this is the need for realizing that employment mediates between growth and poverty, and growth in productivity of labour engaged in agriculture is crucial for poverty reduction. The analysis below also establishes the relationship between the growth rates of per hectare GCF, per hectare agriculture productivity and productivity per agricultural worker.

Growth Rates (%) of per capita productivity of Land, Labour and capital in Agriculture in India: At 1993-94 prices

Period	*Per unit of*	*Per hectare*	*Per Agriculture worker*

	GCF		
1980/81-1990/91	2.9	2.38	2.54
1990/91-1998/99	0.03	1.84	1.05

Source: Reports of Commission for Agricultural Costs and Prices. Department of Agriculture and Cooperation, Government of India.

It is obvious from this analysis that capital formation, productivity of land, and productivity of agriculture labour move together. A high rate of growth in capital formation would lead to high growth rate of land and labour productivity, and a low growth rate to low rates of growth in land and labour productivity. And, the decelerated growth rate in capital formation would lead to decelerated growth rates in productivity of land and labour. The decelerated growth in agriculture sector during 1990s has given rise to low productivity of labour (due to less of capital to work with, among others) and decline in poverty reduction rate.

7.3. Empirical Constructs and Evidences:

The section preceded has brought out the importance of capital formation in growth performance of agriculture, and thereby in productivity of labour engaged in agriculture and the pace of poverty reduction. It is also recalled from earlier section that much of the decline in poverty in India from the mid 1960s to the early 1980s has been attributed to agriculture growth and the associated reduction in food prices (Ahluwalia 1985, Srinivasan 1986, Ghose 1989). Given the above relationship, it is appropriate to specify the empirical constructs for establishing the relationship between capital formation, agriculture growth and poverty. There are some research attempts (Chand 2000, Roy 2001; Gulati et.al 2002; Thorat et.al 2003) to examine the relationships by constructing different empirical frame works and by using different data sets. Cutting across all these, two empirical constructs are specified viz agricultural output growth function and rural poverty function. In general, socio-economic, institutional, and agro-economic variables influence agricultural growth and poverty. The agricultural output could be specified as a function of public investment, private investment, rainfall population growth, rural

literacy, marginal holdings, terms of trade, cropping intensity, village electrification, markets, roads, credit, storage capacity and so on. Rural poverty could be specified as a function of AGDP, public investment in agriculture, private investment, population growth, marginal holdings, rural literacy, village electrification, terms of trade, total government expenditure on poverty alleviation, roads, markets, credit and so on. It is obvious from the specification of these two functions that simultaneous equation model, using two stage Least Square Estimation (LSE), would constitute the relevant empirical construct. Some of the empirical evidences are reproduced from earlier studies by Bisaliah (2004, 2009). Before the examination of empirical results, it is appropriate to discuss some of the methodological issues involved (Bisaliah 2004): First, capital investment is a determinant of agricultural growth, but agricultural growth could also be a determinant of capital investment, particularly in case of private investment. Second, the impact of total investment on growth could be different from that of public and private investment separately. Third, two alternative measures of public investment viz physical and financial terms may rise to different productivity and output elasticities. Fourth, there are differences in the choice of public capital expenditure heads (recall narrow and broad public investment data series) to assess the impact. Choice of capital expenditure may be in the form of index of agriculture infrastructure, index of transport and communication, research, extension and educational infrastructure, credit infrastructure, and various other definitions and measurement of investment variables. Fifth, what is the time lag between investment and growth response? Does the time lag vary between public and private investment? Sixth, choice of single equation model as against simultaneous equation model may give rise to bias in the assessment of impact of investment on growth performance of agriculture, and thereby difficulties in establishing the causality or otherwise.

With all these methodological issues, there are some studies which have established the relationship between volume and composition of investment on growth performance of agriculture, and the impact of agriculture growth and poverty (Bisalaih, 2004):

A study by Chand (2000), covering the period between 1974/75 and 1996/97 would provide some empirical insights into the casual relationship examined in this section.

First, the impact of public investment alone on both productivity and output growth is found to be positive, but statistically non-significant; but the impact of total of both public and private investment is not merely positive, but also statistically significant. Second, public investment as a determinant of private investment is found to be less important than terms of trade and flow of institutional credit; but the importance of public investment (the composition of which is different) to create infrastructural support and to promote long term agricultural growth should not be undermined. This supports the need for reversing the declining trend in public sector investment in agriculture with measures to improve the efficiency of public investment and changing the composition of private investment to meet the development needs of post-reform period.

A simultaneous equation model has been employed by Roy (2001) to derive both agricultural productivity equation (to identify the determinants of agricultural productivity) and rural poverty equation (to identify determinants of rural poverty). The analysis has estimated the effects of various economic, agro-climatic and institutional variables on agricultural investment, productivity and rural poverty. With respect to the relationship between agricultural productivity and investment, and between agricultural productivity and other explanatory variables, certain useful results to provide direction for policy reform could be sorted out. First, the impact of per hectare investment on per hectare agriculture GDP is found to be positive and statistically significant. Though agricultural GDP and its growth did not decline as predicted during the later part of 1980s following decline in public investment, there is no disagreement about the importance of public investment for long run output growth. Second the impact of rural literacy, proportion of area under marginal holdings, per hectare storage capacity, cropping intensity, agricultural subsidy, terms of trade, per hectare institutional credit and rainfall on agricultural productivity are found to be both positive and statistically significant. The impact of cropping intensity captures the effect of irrigation and seed-fertilizer technology, and estimated productivity model does not include rural market and electricity consumption because of multi-collinearity problem with storage and rural literacy rates. Third, instability in Government expenditure on agriculture is found to be inversely related to the growth in agricultural sector. Fourth, among other variables public and private investment in agriculture are found to have positive impact on AGDP and thereby

poverty reduction. This establishes the agricultural productivity / production enhancing and poverty reduction effects of investment in agriculture.

It is appropriate to examine details on the results from rural poverty function estimated by Roy (2001). First, while private investment is found to have played significant impact on poverty reduction, public investment does not appear to have direct impact on poverty. But public investment has positive impact on agriculture productivity which in turn contributes for poverty reduction through employment and wages. In fact agriculture investment affects rural poverty directly and indirectly. While indirect effects arise mainly through gain in agriculture productivity, direct effects arise from wage earning opportunities for the poor. Second, there is a positive association between population growth and poverty, implying population growth as a contributory factor for increase in poverty. Third, rural literacy, village electrification, terms of trade, rural roads and credit flow to rural sector are found to have positive impact on poverty reduction. It is quite obvious that decelerated agriculture growth and accelerated growth in service sector (which does not generate demand for unskilled rural labour) are bound to give rise to slowdown in poverty reduction. Further, investment in agriculture helps to reduce poverty directly and indirectly through agriculture growth by improving employment and wages in rural sector and reducing the prices of staple food items (Thorat et.al 2003).

In yet another important research study by Gulati. et.al (2002), the relationship between investment in agriculture and GDPA has been explored, using data for the period 1980/81 to 1998/99 at 1993/94 prices. The analysis with simultaneous equation model in reduced form has provided a major useful inference. The study has observed significant positive impact of both public and private investment on the growth of AGDP. Whatever the concept of public investment used (Concepts I, II and III as discussed under section 5.2), public investment (measured both in physical and financial terms) is found to have positive significant direct impact on AGDP and indirect impact through its inducement effect on private investment in agriculture. Hence, decline in public investment in agriculture would affect agricultural output growth through both direct and induced effects. Further, the positive and significant impact of terms of trade and gross cropped area on agricultural output growth is also evidenced with the analysis.

The relationship between agricultural productivity and infrastructure variables such as transport, power, irrigation, credit, marketing, research, extension, fertilizer, tractor, communication, education and health has been identified by Thorat (2003). Among various infrastructure variables, irrigation, power, research and transport are found to have a great influence on agricultural productivity and output growth. Hence, public investment impacts agricultural productivity/production directly and through its inducement effect on private sector investment in agriculture is very well established.

A recent study (Chand, 2004) has attempted to establish the relative importance of public sector investment in agriculture and subsidies in influencing AGDP, among other determinants of AGDP such as terms of trade, net sown area and rainfall. Instant return to one rupee public expenditure on subsidies is found to be much higher (Rs.3.19) than the impact of one rupee increase in capital stocks on AGDP (Rs.0.61). But this is the impact of only one year. But, if one year impact of capital stock on AGDP is multiplied by the expected life of capital stock, that total impact has turned out to be more than double the impact of subsidies. In view of this trade-off in public resource allocation between subsidies and public capital investment, the diversion of public resources in a phased manner from subsidies to public investment is suggested. Another study (Jha 2007) suggests that stagnant / declining agriculture investment, decelerated agriculture growth, and slow down in rural employment would obviously lead to slow down in poverty reduction.

With all the methodological complexities related to the choice of data set on investment and the measurement of investment, choice of explanatory variables to account for variations in agricultural productivity/production, and the choice of statistical models, a few inferences on the relationship between capital formation and agricultural growth would follow. First, capital formation in/for agriculture has positive impact on agricultural productivity and output growth. Second, other variables like terms of trade and technology are found to have positive impact on productivity and output growth in agricultural sector. Third, public sector investment becomes a crucial factor to impact the growth of agricultural sector, both because of its direct and inducement effects. Fourth, the impact of public investment on AGDP is found to be more than double the impact of subsidies. Fifth, any policy failure to reverse the declining trend in public sector

investment would adversely affect the growth in agricultural sector, which in turn would affect adversely the growth of non-agricultural sector and thereby the growth of general GDP through both supply and demand linkage of agricultural sector with non-agricultural sector all leading to slow down in poverty reduction in India with implications for the 'ability' of India to honour Millennium Development Goal of having poverty by 2015. This is also established by the concomitant occurrence of high rate of capital growth in agricultural productivity (of land and labour), and high rate of poverty reduction. This also implies that low rate of growth in capital stock and low rate of growth in agriculture productivity and lower rate of poverty reduction are the development experiences of India.

8.0. Some Substantive conclusions and Policy Initiatives:

Following the discussions on the theme outlined for the study (Section 1), this section is an attempt to derive some major substantive conclusions and the needed policy initiatives in developing countries. The first part of this section is designed to derive conclusions and policy initiatives, based on cross country experiences as related to growth (general and agricultural), the role of capital as one of the growth drivers, the nexus between growth and poverty, agriculture as a pro-poor growth sector, and the nexus between agricultural capital stock, productivity of labour engaged in agriculture and prevalence of hunger in developing countries.

8.1. The concept of capital has been evolved over a period of time to encompass physical capital, human capital, social capital, natural capital, knowledge capital (R & D), institutional capital (governance) and infrastructure capital. However, the problem of measuring the concept of capital in the broad sense and the construction of a composite measure of it are still elusive. In this broad sense, capital is considered in the matrix of deep drivers of growth. With respect to 'role' assigned to capital in three theoretic models viz the Classical Growth Theory, the Neo-Classical Growth Theory and the New Growth Theory, capital is treated as one of the major drivers of growth. Further the new growth theory opens up the avenues for getting into the black box of productivity and understanding it with the broad concept of capital.

- Growth regression methodology has been used for explaining variations in growth performance across countries and for variations in output per worker. Cross country growth accounting through growth regressions has high lighted the importance of TFP not merely as a source of growth but also as a growth sustaining source in the long run.
- Yet another issue is how growth convergence occurs in some countries, while convergence does not happen in some others; instead, growth divergence is deepening and broadening. In a group of seven developed countries (U.S, U.K, Japan, Germany, Italy, France and Canada) the positive interaction between technological advance, capital accumulation and TFP catch up has contributed for bridging 'idea gap' to facilitate movement towards growth convergence. Hence convergence of labour productivity, narrowing differences in capital: labour ratios, and convergence of TFP are crucial for growth convergence.
- A recent study (Senhadji 2000) on sources of output growth in the regions of developing countries has concluded that capital accumulation is by far the most important contributor to measured growth in output in all the regions in relation to the contribution of labour, human capital and TFP. Further the negative contribution of TFP to growth in Sub-Saharan Africa, Latin America and Middle East and North Africa is a matter of concern. In this context TFP itself needs to be specified as function of human capital, physical capital, natural capital, macroeconomic management, governance, knowledge development and diffusion (through R & D), and economic integration with outside world. From the examination of growth-theoretical models and the results from growth accounting through growth regressions, developing countries could derive some lessons for policy-programme initiatives. First, capital accumulation in the broader sense is crucial for growth/development, not merely physical capital. Second, failure to 'catch up' through capital accumulation and technological advancement and sound macroeconomic management, growth/labour productivity / TFP divergence across countries would persist. Third, capital accumulation is important in its own right for these countries; because it is the major conduit for advances in knowledge / technology, for increasing labour

productivity and for increasing TFP which in turn would contribute for growth / development. Capital deepening would make substantial differences to productivity and output growth. Fourth, capital accumulation is considered as an escape from the 'vicious circle of poverty'.

- A study of the nexus between growth and poverty, even though inconclusive, is suggestive of needed policy initiatives in developing countries. The development premise of early development theory was that the benefits of economic growth would trickle down to the poor automatically. Enough evidences have accumulated to question the automaticity of the relationship between growth and benefits to the poor. Cross-Country experiences of developing countries suggest that the impact of growth on poverty depends on sectoral pattern of growth, initial distribution inequalities, and employment generation pattern of chosen growth pattern. Given this inference, 'growth plus interventions' and pro-poor growth policies and strategies are surfacing to the fore in developing countries, even though attempts (For example Dollar et.al 2000) have been made to support the argument that there is one-to-one correspondence between growth and poverty, and growth-maximisaitn policies and strategies would lead to maximization of poverty reduction. But the challenge of developing countries is the translation of growth into development so as to facilitate the emergence of a broad-based growth instead of growth enclaves. Broad-based pro-poor growth means that the poor experiences higher growth than the non-poor (Baulch et.al 1999; Kakwani et.al 2000)
- The imperatives for reinstating agriculture / rural sector at the centre of development agenda of developing countries are emerging for many reasons. First, that poverty is dominantly a rural phenomenon in global hunger spots. Further agro-rural sector is still predominant provider of employment for rural people. Second high agricultural productivity / production is likely to have a significant impact on poverty reduction. Service- led growth and decelerated agricultural growth in India have given rise to slowdown in poverty reduction. Third, high growth performance of agriculture would lead to more non-farm activities and generation of more employment opportunities for the rural poor,

and higher real wages due to fall in prices of food items. Hence the poverty-reducing effects of agriculture growth through development multiplier trends to operate. The value of this development multiplier could be increased through the development of non-farm rural sector and by empowering the rural people with skills to 'fit' into non-farm sector. China has successfully done this. But all these would require public policy support for investment as well as public investment. It is true that policies are needed in support of growth of small holder in agriculture, product diversification (through shift to high value crops), and of raising the productivity and real wages of labourers as a part of pro-poor growth process. In addition, it is also important to have a structural shift towards higher productivity non-farm sector through rapid growth of labour intensive sectors in rural areas, shift of labour force in agriculture to non-farm rural sector so as to facilitate structural transformation in composition of employment pattern. Further, no developed country has reached that status without agricultural sector recording substantial productivity gains. History of growth of countries like Japan suggests the inference that agricultural revolution preceded industrial revolution, and dynamic agriculture has the strongest linkage to growth in other sectors and aggregate growth.

- There are some valuable cross country experiences for developing countries to address the problem of rural poverty to address through agriculture growth. In both China and Vietnam, agricultural growth has not only reduced poverty, and has contributed for general growth. China experience has suggested that growth in TFP and high level of labour productivity.
- Agriculture R & D, rural infrastructure, irrigation, rural growth centers to provide non-farm employment and income opportunities, increased rural labour productivity and high TFP and so on are all crucial for improving the performance of rural growth and for reducing rural poverty. TFP growth in agriculture is found to depend on irrigation, government expenditure on agriculture, rural infrastructure, human capital, agriculture R & D, export and import (proxy variables for 'openness'), rural literacy, and institutional factors like land distribution. Added to this redistributive land reforms coupled with

rural education are said to provide an important tool for the poor to expand and diversify their employment opportunities and increasing their earning capacity (Osman 2000). All these would need increase in agricultural capital stock as a major driver of agriculture growth and poverty reduction.

- There are two important studies (Stephan 2009; Schmidhuber 2009) which have attempted to establish the role of agricultural capital stock (ACS) in influencing productivity of labour engaged in agriculture and prevalence of hunger in developing countries. The relevant result for the present study is that growth in ACS tends to have positive impact on labour productivity and negative impact on prevalence of hunger in developing countries. Further, an important factor that explains the difference in output per worker in agriculture is capital stock per worker, among other factors.
- An examination of the results from cross country studies on agriculture productivity growth leads to the inference that capital deepening is vital, and inadequacy of capital stock would affect productivity-augmentation and poverty reduction in developing countries.
- While emphasizing the importance of capital accumulation in enhancing the growth performance and in reducing poverty it is absolutely important to recognize the difference between capital accumulation and capital assimilation (Nelson et.al 1999) over the past three decades or so, South Korea, China and Singapore have transformed themselves from technologically backwards and poor to relatively modern and affluent (in relationship to what they were earlier) countries. All these countries have experienced rapid growth of their physical capital stock, and all have been marked by very high rates of investment in human capital. Accumulation theories emphasize the role of capital in moving along their production functions. But the assimilation theories stress the entrepreneurship, innovation and learning that these countries have gone through before they could learn to use effectively the new technologies they were adopting from the more advanced nations, learn new ways of organizing economic activity, and become familiar with and competent in new markets. Hence high growth is a process which needs a combination of both capital

accumulations and assimilation. This is what the developing countries have to learn from what is called 'Asian Miracle'. Human capital in the broader sense (education, health, skills, innovation, entrepreneurship) would determine the capacity of a country to absorb physical capital and technological progress. That is why Lucas (2002) argues that human capital enhances the productivity of both labour and physical capital, and it accounts for major differences in living standards among nations.

- A brief reference to ADB policy stand (Hughes et.al 2008) on choice of growth pattern to reduce poverty in developing countries is in order. The ADB policy stand is that general growth can reduce poverty (through not one-for-one), but labour intensive growth can reduce it even faster. Added to this is the U.N. Millennium Development Project (2005), wherein one of the interventions is investment in rural development and pro-poor growth. While putting pillars of sustainable human development, the International Future Modeling System of this Project recognizes 10 major modules of which agriculture is one. In this model, capital, labour and TFP are recognised as deep drivers of economic growth. Both the ADB policy stand and Future Modeling System could provide lessons for developing countries in making choice of growth pattern and policy-programme mix for addressing their 'Grand issues' of development like poverty and unemployment.

8.2. The second part of this section is designed to arrive at major conclusions and policy initiatives, based on case study of capital formation, agriculture growth and poverty in India. The Indian case study has focused on examination of analytical and empirical evidences as related to development of data set for a study of this kind, investment behaviour of decision making units (Government and private sector), trends in the levels of and compositional shifts in agriculture capital formation, complementarity between public and private sector investment, and impact of capital formation on agriculture growth and poverty reduction. The focus of this case study of India is expected that it would facilitate cross-country studies on the theme of this study and the development experience of India in this area would provide messages

for other developing countries to sharpen the nexus between capital formation, agriculture growth and poverty.

- Any attempt to forge the nexus between capital formation, agriculture growth and poverty should keep in view the context, complexity and concerns of agriculture system of the country. In this context, India is a country of marginal and small farmers, of falling share of agriculture in national GDP, of agriculture sector absorbing about 60% of labour force, of decelerated agriculture productivity growth, of a large pool of poor people parked in rural area, of low agriculture labour productivity, of low and declining TFP, of depletion and degradation of natural resource base, of high degree of development dualism in agriculture with development segmentation in rural sector, and of falling investment in agriculture. With all these, agriculture is still the lifeline for over 65% of the population of the country without any other development avenue.
- One of the challenges for the researchers to work on capital formation in Indian agriculture has been the development of data set. The challenge gets sharpened once the distinction between capital formation in and for agriculture is drawn. The narrow dataset, compiled by central statistical organization (CSO) of Government of India, is a part of National Accounts Statistics (NAS) in accordance with the concepts and definitions in the system of National accounts (SNA) of the United Nations. The estimate made by CSO provides break-up of public and private investment (suing the data generated by other agencies on farm investment, machinery, irrigation, land reclamation and land improvement). Public sector investment includes mainly investment in irrigation schemes, and plantations in the forestry sector, with irrigation alone constituting about 90% of public investment in agriculture. The individual researchers have developed the broad data series, by using data available on capital expenditure incurred by Government on agriculture, related investments like investment in fertilizer and pesticide industry, rural roads, rural electrification, and agriculture education and research. The Committee on Capital formation in / for agriculture (2003) has carried forward the concept of broad data series, and has made useful recommendations relating to data set on capital formation in / for agriculture.

One more area of methodological work is to test the raw data on capital stock for its sationarity, and find out the need for using co-integration method.

- Capital formation in agriculture as proportion of total GDP and total capital formation in the economy and in terms of capital stock growth rates has experienced deceleration since 1980s, indicating a loss of momentium in capital formation in Indian agriculture. This decelerated growth in agriculture capital stock has been mainly due to fall in public sector investment. Agriculture is basically a private activity, and public sector has a critical role to play in creating rural infrastructure, irrigation, technology development and transfer. Public investment affects directly growth performance of agriculture, and indirectly through its inducement effect on private sector investment. Further, the decline in public investment with its adverse impact on growth performance of agriculture sector would contribute for economy wise slowdown through supply and demand routes. Hence the need for reversing the declining investment both by public and private sector in agriculture and agriculture business.
- In addition to downward shifts in capital formation in agriculture, (even though some marginal recovery during recent years) compositional shifts as between the percentage share of public sector and private sector in total investment has also taken place. The percentage share of public sector in total investment was 43% in 1960s, and it declined to 24% in 2005-06, suggesting that private sector had increased its share from 57% to 76% during the same period. It needs to be kept in view that public and private sector investment cannot be treated as substitutes. For example, public investment is mainly (apart from investment in infrastructure, agriculture R & D and so on) in medium and major irrigation works, while private investment is in minor irrigation, mechanization and land development.
- The investment behaviour of public sector and private sector is not the same. While private sector fixed farm investment could be specified as a behavioural function, public investment is deemed to be exogenously determined in the sense that political economy compulsions determine the level and composition of public investment. Private investment is found to be positively impacted by

public investment, terms of trade, technology, institutional credit, and negatively impacted by incidence of rural poverty and percentage of area under marginal holdings.

- The debate on the impact of public investment on private investment is still inclusive. Depending on the data set, time frame and model specification there are four propositions derived on complementarity or other wise between public and private investment. First, there is a crowding in or positive inducement effect of public investment on private investment, suggesting strong complementarity between these two types of investment. Second, there is only weak complementarity between these two types of investment. Third, there is no apparent complementarity. With all the difference in inferences drawn on complementarity, the broad inference suggests that the inducement effect of public investment on private investment is quite strong. Certain types of public sector investment are quite crucial even to induce corporate sector to invest in agriculture. Hence from the view point of long term agricultural growth, lack of strong or weak complementarity should not underestimate the importance of public investment. The challenge lies in identifying right priorities for public investment by keeping in view the varying priorities depending on stage of agriculture growth / development, broader development policy agenda, and more inducement effect on private farm household and private corporate sector investment.

8.2.1. Indian economy has entered the high growth trajectory during the last two decades or so. But agriculture ahs become an excluded or bypassed sector in the high growth trajectory. There has been a deceleration in the growth rate of AGDP, hitting less than 2% per annum. Many of the problems of rural sector viz low productivity, low employment opportunities, low infrastructure and high intensity of poverty are attributed to progressive decline in capital formation. Growth rates of per capita productivity of land, Labour and Capital in agriculture have declined between 1980/81-1990/91 and 1990/91-1998/99, suggesting the importance of capital stock in land and labour productivity. Further trend growth rates in capital stock, technology, gross irrigated area, electricity use and cropping intensity in

agriculture have decelerated between 1980/81-1990/91 and 1996/97-2005/06, and have impacted adversely growth performance of agriculture and tempo of poverty reduction. Added to these is the development experience of India that the period of high rate of poverty decline has been the period of high rate of growth of agricultural output. All these recapitulations and conclusions are suggestive of the nexus between capital formation, agricultural growth and poverty.

- There are some methodological issues (like time lag between investment and growth response, choice of measurement of capital expenditure in agriculture, and choice of equation for estimation) to establish the nexus between capital formation, agricultural growth and poverty. With all these methodological issues, the positive and significant impact of investment in agriculture on productivity and output growth has been empirically established. In a multivariate framework, the impact of investment, rural literacy terms of trade, institutional credit, cropping intensity (a proxy for the impact of irrigation and seed-fertilizer technology), and rainfall on AGDP are found to be positive. Further the relationship between agricultural productivity and infrastructural variables like transport, power, irrigation, and research is found to be quite strong.
- Agricultural productivity enhancing and poverty reducing effects of investment are well established. Private investment is found to have positive and direct impact on poverty reduction, whereas public investment has positive impact on agricultural productivity which in turn contributes for poverty reduction through employment and wages. In addition to the impact of investment on poverty via agricultural productivity, rural literacy, village electrification, terms of trade, rural roads and credit flow are also found to have positive impact on poverty reduction.
- All these evidences drive to the conclusion that high rate of growth in capital stock would lead to high rate of growth in agricultural productivity and high rate of poverty reduction.

8.2.2. This section derives certain policy initiatives for strengthening the nexus between capital formation, agriculture and poverty in India. Following the identification of investment growth cycle, adverse impact of decline in agriculture investment on growth performance of India agriculture and on poverty reduction, the study by Bisaliah (2004) has indicated the policy direction and reform agenda for capital formation in priority areas of public investment, improvement in efficiency in public investment, and favourable policy regime for private investment. Since these policy directions and reform agenda are relevant in the context of the present study, a brief summary of these is presented wherever relevant.

- There are many domains in which policies are needed for revival of Indian agriculture so as to lead the sector from decelerated to accelerated growth trajectory. Among critical areas of agricultural policy, capital formation is a major policy domain. Judious use of natural resources for sustained agriculture growth, adoption of advanced technology, development of infrastructure, ensuring food security and making agriculture a profitable enterprise are the issues which can be addressed with a strong capital base in / for agriculture. But one of the disquieting developments in the domain of capital formation is fall in public investment in agriculture during the last two decades or so. The reasons for the decline in public investment are many such as diversification of resources from capital to current expenditure in the form of subsidies, large amount of expenditure on maintenance of existing projects delay in completion of projects, failure to realize the importance of non-price interventions for agriculture growth / development, in addition to setting the prices right, and non-agriculture hiatus in the allocation of public sector investment funds.
- The debate on the role of subsidies vis-à-vis investment in agriculture has generated enough research efforts (Mundle et. al 1991; Gulati et.al 1995 and 1997; Roy 2001; Chand 2004; Thamarajakshi 1999; and others). It is argued that subsidies in Indian agriculture, even though not high compared to developed countries, have become unsustainable. Subsidies especially on fertilizer, power and irrigation water are crowding out productive investment. The direct fiscal effect, cropping pattern effect, environmental effect and

equity effects of subsidies are far from desirable. The desired Fiscal disciple as a part of economic reforms in India has led to cut back on public investment in agriculture, but not cut back on input subsidies. For example, a modest subsidy reduction, say 20% would enable Government to double its investment in agriculture (Uma, 2009). The study by Chand (2004) has estimated that instant return on one rupee subsidy is about three rupees (in terms of impact of subsidy on AGDP), and less than one rupee return on one rupee public investment in capital stock. But this is the impact of only one year. If one year return to investment in public sector capital stock is multiplied by the expected life of capital stock, the total impact is estimated to be more than double the impact of subsidies. These results would point towards downsizing subsidies in a selective phased manner and plough back the resources to increase public investment is agriculture. Added to the increased public investment is the needed institutional reform for improving terms of trade in agriculture, instead of treating downsizing of subsidies as an independent policy instrument. In fact, the Tenth Five Year plan of India (2002-07) has called for a review of policies which led to the diversion of scarce resources away from the creation of productive assets, and the reverse the declining trend of public sector investment by better targeting subsidies. Political economy compulsions appear to be still strong enough to prevent quick actions on this call for a revision of policies on allocation of public resources.

- In formulating policies towards public investment in agriculture, three areas of priority suggested by Panagariya (2008) are rural roads, electricity and major and medium irrigation projects. Technology development and transfer, development of rural non-farm sector, development of marketing system for agri-business, rural human capital, and development support for sunrise sectors like horticulture and livestock are some other major priority areas for public investment. Some of these priority areas of public investment need specificity through a little more elaboration.

- The enhancement of public investment in irrigations needs to be coupled with some reforms, because the public sector investment portfolio in

agriculture irrigation constitutes the single largest component and there is much to be desired in the management and operational efficiency of irrigation projects. Policy initiatives are required for coordinating the choice between new projects and better utilization of existing ones. There has been a persistent gap between irrigation potential created and actual utilization of irrigation water. Adequate investment has to be made for increasing operational efficiency of irrigation systems so as reduce conveyance losses, distribution and utilization of water. Further efficiency of irrigation would also depend on promotion of institutional structures like water user association, water syndicates like the ones in France, and village level committees for management of tank irrigation system. Public investment for renovation of water bodies initiated by Government of India could prove to be a right step for rehabilitating tanks and other traditional methods of water harvesting and storages, if the gap between public investment outlay and outcome is reduced through proper governance including public private participatory mode.

- There has been an increase in funds for public investment, particularly for State (Regional) governments, with the activisation of Rural Infrastructure Development Fund (RIDF). But the challenge is the choice criteria for deciding portfolio of State Government investment. In addition to providing funds under RIDF to the State Governments for the lines of investment prescribed, funds could be provided for setting up food processing units / food parks, production and export of medicinal and aromatic plants, and for re capitalization of cooperative banks.

- Public investment is required for addressing the problem of inadequacy of rural infrastructure. Without this, stimulating private sector to enter into fast-track privatization syndrome will not occur.

- Public investment in agricultural science and technology is yet another important priority areas to search for new sources of productivity growth. The present level of public investment intensity in agriculture research is a

low as o.5% of AGDP, whereas in the western countries it is about 2% . It is reported (Golait et.al 2008) that out of the total investment made in the world on agriculture science and technology during 2000, developed countries shared about 62% and developing countries 38%. Infact, the rate of return to investment in agriculture research is found to be the highest (50%) in Asian Region (Altson et.al 1998), implying under investment in agriculture science and technology at present.

- Related to low investment in agriculture science and technology is low and falling TFP in agriculture. India needs productivity-led growth in agriculture in view of land-constraint. It is possible only through investments in land-augmenting technologies like irrigation, new crop varieties and so on. In view of this, an examination of trends in the behavior of TFP in Indian agriculture is in order, because TFP shifts production function upwards and unit cost function downwards, and both are efficiency measures which could help India to experience transition from protective to competitive liberalized regime. The TFP growth is attributed to agriculture science and technology, irrigation, modern agricultural implements and rural infrastructure. But the growth rate of TFP has been falling overtime. (Ranjita 2005). In a recent study, Tripati (undated), covering data for a period of 37 years (1969 to 2005), has concluded that agriculture growth in India relied almost on increase in conventional factors (land, labour and capital), while TFP growth was negative, with some positive value for the period of 1991/91 to 1995/96. Even though the contribution of TFP to agriculture growth in India was -0.11 for 37 year period, for the period (say Post WTO period) between 1996/97 and 2005/06 it was -1.87. Unless there is tangible growth in TFP, a measure of the collective contribution of non-conventional inputs in agriculture such as technology, and improvements in input quality, agriculture output growth in India will continue to stagnate or growth will be only marginal. The stagnation /declining TFP has serious implications for sustaining productivity growth which is critical for achieving food security, poverty reduction and broad based economic

growth. Further, it has been estimated (Mittal 2005) that TFP growth has been declining in wheat farming (a major food grain). As a result, the future production growth will have to be conventional input-based in many regions of the country. With the decomposition of sources of TFP growth in Wheat farming in India, over 90% has been attributed to public research and irrigation (Also see Dholakia et.al 1993; Desai et.al 1998, Chand 2005 and others on the importance and methodology of estimating TFP and related issues. See Kumar et.al 2005 for TFP estimate for livestock sector) Hence importance of decline in TFP is yet another compelling reason for increased public investment in agriculture.

- Rural economic diversification through the development of non-farm sector would require investment. Development of non-farm sector could become an escape route for agriculture workers, for reducing demographic pressure on land and for diversifying income and employment opportunities for the poor. Chinese experience (Dev, 2008) on rural transformation offers several lessons to India as well as to other developing countries. Chinese Government has recognised that agriculture growth is only a necessary, but not a sufficient condition for alleviating poverty. Chinese rural industrialization strategy is a case in point. The rural township and village enterprises have grown rapidly, following Rural Reform of 1979 and now play a significant role in Chinese rural income growth. Chinese development experience shows that globalization with better initial conditions (like land reforms, investment in rural infrastructure, and in health and education) could increase employment and incomes of workers, which in turn has been due t o rural economic diversification. Developing countries should learn from Chinese experience on agricultural growth, development of rural non-farm sector, human development and public investment. For example, infrastructural investment was 19% of GDP in China as compared to 2% in India in the 1990s (Dev, 2008). Further Vietnam experience of crop diversification by farmers to shift from low value to high value crops with the support of technology and infrastructure (including markets) due to

public investment offers another useful perspective on rural growth and poverty alleviation. All these would need the support of 'big push' in public investment in priority areas so as to reinstate agriculture in the top of development agenda.

- As a part of policy support for private investment (with over a share of 75% in total investment in agriculture), Government has to create a favourable policy regime and development support for farm household sector (forming about 95% of private sector investment) and corporate sector (either domestic or foreign agribusiness investors with proper regulatory system). More public investment in technology, infrastructure, institutional development, reforms in institutional credit system, management and more efficient management of public infrastructure, for building natural resource base is crucial for providing proper development environment for private sector to invest (See Bisaliah 2004 for details on private sector investment and the needed policy support)

- The policy issue (Bisaliah 2004) that has not received much attention is substitutability (within some limited range) of institutional transformation for public investment. Institutional transformation can get reflected in social capital formation such as preparing stake holders for collective management of programmes / participatory management / community management / joint management / decentralized management / user participation. The concept of social capital can be operationalised with local groups for watershed management / integrated pest management / microfinance delivery, and by developing networking through information technology. These local groups, supported by external professionals, could contribute for augmentation of human capital in rural areas for enhancing the productivity of present level of agriculture investment. This could be treated as managerial technology for shifting the production function especially of public investment upward and unit cost function downwards, without increased public investment. Because this would decrease ICOR.

- Yet another important of concern is the low productivity of dry land farming (occupying over 60% of cropped area in India) due to hostile agro-climatic regime, and where the majority of the rural poor live. These 'non-elite' farmers need to be prepared to assimilate technology, management and marketing dimensions of agriculture growth. Farmers in these regions are confronted with degraded and depleted natural resource base, biological disequilibrium, and adverse effects of climate change. If the farmers of these dry land regions are oriented in development culture through development education with public policy support and participation of voluntary organisations, production potential of dry farming itself could be a new source of agriculture growth in India (Dwarakinath 2009). Reaching these 'un reached' through the strategy of 'Building on the Rest' (not merely 'Building on the Best') through public investment could help Indian agriculture to overcome the stagnant / decelerated growth in agriculture. Hence in the absence of 'Big Push' in agriculture investment with enhanced public investment and with favourable policy environment for private sector to invest in agriculture, the problems of food in-secured regions and people (not merely in terms of food availability but also in terms of accessibility with adequate purchasing power), widely prevalent malnourishment and undernourishment (accelerated further by food price inflation) especially of children and women, and high intensity of hunger among lower strata of Indian society would continue to persist.

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