Chapter 2

Literature Review

2.1 Introduction

Assessment of growth performance in Indian agriculture is not new in the literature. However most of the earlier studies are limited with the computation of trend growth rate (see for example Panse, 1964; Dey, 1975; Reddy, 1978; Narain et al., 1982; Kumar and Rosegrant, 1994; Kumar, 1997; Joshi and Saxena, 2002; Singh and Srivastava, 2003). However, the procedure being followed for computation of growth rates has a number of serious lapses and therefore the conclusions drawn are not statistically sound. Accordingly, the aim of the present study is to highlight the discrepancies in computation and suggest more efficient procedures that may be adopted to achieve the task.

The Indian economy has undergone structural changes over time with the anticipated decline in the share of agriculture in the GDP. Agricultural sector is the mainstay of the Indian economy, contributing about 15 per cent of national Gross Domestic Product (GDP) and more importantly, about half of India’s population is wholly or significantly dependent on agriculture and allied activities for their livelihood (GOI, 2011). Indian agriculture is marked by the presence of considerable degree of
unevenness in the pattern of growth among various regions. Various studies have indicated this and tried to identify the possible factors behind this phenomenon (Vaidyanathan 1980; Rudra 1982; Swant and Achuthan 1995).

Most of the authors argued that the uneven economic differences in agricultural development in India are due to the uneven resource endowment with considerable region-wise variations in rural investment, infrastructural development as well as technological innovations. Since economic growth is associated with some notion of welfare concept, comparison of growth performance over time and across regions seem to be oblivious of the inherent welfare indicators. Such comparisons are necessary particularly in studying a backward economy where the destinies of millions are closely involved with the success or failure of growth.

In section 2.2 of this chapter we discuss about some of the existing methods for growth analysis in respect of Indian Agriculture. Some of the earlier studies of the growth in Indian Agriculture pointed out in section 2.3. Section 2.4 capture some of the earlier studies related to efficiency in agricultural sector. In section 2.5 we discussed the weakness of earlier studies and point out the importance of our study.

2.2 Existing Methods for growth analysis in Agriculture:

The subject of growth analysis in agriculture is a tricky area, especially because of the high degree of volatile fluctuations in agricultural production data and the dependence on a number of factors such as the choice of the periods, cut of points, the statistical techniques employed etc. For these reasons there is a need for a systematic inquiry into these aspects of the problem. Also there is a need for caution in interpreting the results. These points have been taken up in a number of studies made earlier [Minhas and vaidyanathan (1965), parikh (1966), Sen(1967), Rudra (1970,1982), Narain(1977), Reddy (1978), Das (1978),Bhalla and Alagh (1979), Vaidyanathan(1979), Srinivasan (1979), Dandekar(1980),Ray (1983), Sawant(1983), Mahandradev (1987), Boyce (1987), Hanumanta Rao(1992), Saha and Swaminathan(1994), Swant and Achuthan (1995), Bhalla and Singh (1997), Chand and Chauhan, (1999), Gollin et al., (2002), Rao (2003) Majumdar and Basu,( 2005), Joshi et al., (2006) Chand et al., (2007); Balakrishnan et al., (2008); Bhalla and Singh, (2009);
Reddy and Mishra, (2009); Vaidyanathan, (2010) etc]. Research activity related to measurement of agricultural growth is largely a post independence phenomena in India, mainly because of significant improvements in data base and researchers’ urge to identify the factors lying behing the agricultural stagnation and development. Apart from the earlier growth calculations either by comparing two arbitrarily chosen end points or by comparing two averages of some arbitrarily chosen periods at the beginning and end of the series, the normal statistical procedure, used in most of the studies, to obtain measure of growth rate, is to postulate a hypothetical trend function and to estimate its parameters (by ordinary Least Square method) which offer the measure of growth rate over a period. in this normal statistical procedure three problems crop up. These are (i) Choice of trend equation, (ii) avoidance of volatile fluctuations in the data set and (iii) estimation of sub period growth rates. The other two problems relating to growth measurement exercise, on which most of the scholars have paid their due attention are: (i) Decomposition of agricultural output growth into its components and (ii) the identification of growth contributing factors. We discuss below the contributions of the researchers to each of these problem areas.

Most of the researchers used the trend equation for the purpose of growth estimation in the form of linear Parabolic, exponential, log quadratic, higher degree polynomial and S type growth curves (Gompertz, Logistic, etc) which have their own interpretation and restrictions upon the character of the growth process for example linear trend implies constant absolute growth. Similarly exponential or log linear trend implies constant compound growth rate. Although parabolic and log quadratic trends are more flexible then linear and exponential in that they permit non-zero second derivatives with respect to time (Implying acceleration or deceleration of growth process). They nevertheless impose restriction that the second order derivatives are constant. Finally the log –quadratic trend, S type growth curves [applied by Rudra (1970), Day (1975), Reddy (1978), Das(1978),Chattopadhyay and Bhattayachariya (1986), etc] are also open to the criticisms regarding the behaviour of the acceleration/deceleration in the growth process. Further the results of non linear estimation procedures [either by ‘Group Average Method’ or by ‘Transformation Approach’ as prescribed by Reddy and Chattopadhyay et.al. or by search techniques] are not comparable with the results of the OLS methods.
2.3 Some Earlier Studies regarding growth in Indian Agriculture

There are a number studies on measurement of growth in area production and yield of crops at regional, state as well as national level by taking different time period. Most of the studies which covered 10 to 20 years since the adoption of new technology concluded that growth in agricultural production has increased with the adoption of new technology (Mehra, 1981; Hazell, 1982; Ray, 1983; Rao et al, 1998). In contrast to the finding of these studies Dev (1987) reported a progressive but marginal decline in growth in food-grains production at the all India level and mixed result at the state level. All these studies covered the period up to late 1970s or mid 1980s which represent the initial phase of modernisation of Indian Agriculture. Another set of studies on growth in Indian Agriculture, extended over a longer post Green revolution Period or covering the post reforms period.

Mukhopadhyay (1976), in his study on sources of variation in agricultural productivity, covering the period 1959-60 to 1968-69, documented the important factors associated with space and time to differences in agricultural productivity. The study essentially shows that the conventionally measured inputs account 40 percent of the variation of the farm output among the major wheat growing districts in India. Using a new methodology, initially developed by Balestra and Nerlove, his study has been able to partition much of the variation in output that is not explained by measured inputs among regional effects, such as those associated with differences in climate and resources, and time effects such as differential fluctuations in rainfall and other natural factors.

Ester et al, (1977) discussed about the regional differences in agricultural productivity in the rice and wheat regions of India for the period 1959-60 to 1968-69. He analysed the contribution to total output of not only the quality of traditional inputs (land, Labour, fertiliser, etc.) but also the quality of certain inputs, particularly irrigation, technology, environment factors (soil types, rainfall, etc), and infrastructure (transportation, markets, etc) by using production functions. According to his observations, the output growth in wheat regions are attributed with the increase in quantity and quality of irrigation and improved cropped varieties. Whereas for rice region, the development of rural roads and markets, increase in irrigation quality, and improved rice varieties are important sources of output growth.
Nadkarni and Despande (1982) carried out an analysis on agricultural growth for Karnataka state for the period from 1955-56 to 1975-76. They noted that concentrated growth efforts in areas with assured rainfall or irrigation can avert increased instability. However, such areas are limited. Indeed, no growth in agriculture could have taken place without farmers taking risks.

Sawant (1983) examined the performance of Indian Agriculture and observed that deceleration in the trend in growth rate of foodgrains production was set by the early sixties after an impressive performance of growth during the fifties which was mainly due to expansion in area. Deceleration in the rate of growth of food-grains production was arrested with the onset of the Green Revolution in Indian agriculture but reversal of the process of deceleration could not be sustained without interpretation beyond 1970-71. In terms of overall performance during the entire post Green Revolution period, Punjab, Maharashtra, Haryana, Andhra Pradesh, Gujarat, and Karnataka did relatively better than the remaining states of India. Among them, however, the performance was consistently good and substantive only for Punjab and Andhra Pradesh. The states which substantially contributed in pushing up the all India growth rate of food-grains production particularly in the latter half of the seventies in comparison with the early seventies, were Punjab, Haryana, Maharashtra, Gujarat, Uttar Pradesh, Orissa and Jammu & Kashmir. On the contrary the contribution of West Bengal Rajasthan, Madhya Pradesh, and Kerala was rather negative due to substantial deterioration in their process of growth since 1975-76. Food-grains production in Assam and Bihar was almost totally stagnant after 1975-76. The major contribution to relatively accelerated growth in foodgrains production come from wheat followed by rice. In general, the states with accelerated growth in foodgrains production in the latter part of the seventies performed better even in respect of growth in the production of non food-grains. The data lagging in the growth of foodgrains generally failed even in stepping up the production of non foodgrains, with a very few exceptions. In general the growth rates in the productivity of many foodgrains and non foodgrain crops excluding wheat, jower and cotton were either higher or almost the same in pre green revolution period in comparison with the past 1967-68. The period between 1967-68 and 1975-76 was particularly more sluggish with respect to the growth in the productivity of all the major crops except wheat. The situation improved after 1975-76 due to relatively increased growth rates in yield per hector of rice, jower, cotton, and sugarcane, in
addition to wheat. Crops lagging behind were particularly bajra, maize, and jute. Increased productivity played a major role in relative acceleration of growth in production of major foodgrains whereas the dominant contribution to relatively increased growth rates in production of groundnut, cotton and jute after 1975-76 was from area.

Bhalla and Tyagi (1989) estimated the special pattern of the levels and growth in agricultural output in the country by taking 19 major crops. Accordingly they argued that with the adoption of seed fertiliser technology, agriculture in major parts in India has undergone a significant transformation. The yields level of some crops have experienced phenomenal rise, thereby accelerating the growth of agricultural output in states where these crops constitute an important component of cropping pattern. Whereas during 1962-65 to 1970-73, the green revolution was confined to only a few North-Western states, it seems to have gradually extended to many other parts of India during the seventies. Punjab Haryana and western Uttar Pradesh continue to be the main beneficiaries of the gains of new technology. During second period, the green-revolution technology was extended to southern region of Andhra Pradesh and central region of Gujarat. Some negative features of the recent growth pattern are worth nothing. Firstly, major eastern states continue to have very low rates of growth in agricultural output. In fact their growth rates in agriculture are perceptibly lower than their growth rate of population and even male workforce. Secondly, the performance of Tamil Nadu has deteriorated quite significantly. Although drought is being given as the main reason for deceleration, it appears that, of late, investment in infrastructure like irrigation, etc, has not been sustained as the same level as during the earlier period. Thirdly, it appears that the fluctuation in agricultural output continue to be very large in the central states like Maharashtra, Rajasthan and Madhya Pradesh. These negative features have primarily risen due to lack of adequate investments in irrigation and other rural infrastructure. It has been noticed that high level of yield as well as high growth rates are primarily associated with high use of modern inputs. Further, high level of using modern inputs is dependent on availability of assured irrigation. They suggest that large investment will be required to increase irrigated area as also to undertake watershed management in the central arid region and also much larger attention will have to be paid to research in dry-land farming.
Mitra (1990) examined the growth rates in production, area and yield of food-grains for Maharashtra for the period 1956-57 to 1984-85. By fitting a semi-log exponential equation, the study analyse the trend growth rate the growth and instability of agricultural production in Maharashtra and in its four regions in order to ascertain if the instability has increased in the period characterised by relatively high growth rate in the context of technological change and irrigation development. The analysis indicates that the annual compound rate of growth of agricultural production in the state as well as in all the regions, especially that of food grains was relatively higher in the twelve years period ending 1984-85 after a near stagnancy in the sixteen year period ending 1971-72. Further the overall rate of growth of around 2% per annum in the production of food-grains has been mainly brought about the growth rate in yield.

S D Sawant and C V Achuthan (1995) has made an evaluation of agricultural growth performance by analysing the crop output growth and the sources of growth, at the national and the state level for the period 1967-68 to 1992-93. Their argument clearly states that Indian agricultural growth across crops and regions in the post green revolution period unfold interesting dimensions of the new trends and patterns emerged in the 1980s. One thing is clear that there must be an upsurge, a significant one. In the growth of aggregate production and productivity in Indian agriculture and it cannot be attributed merely to a favourable weather. The fact that the role played by yield improvement in inducing higher output growth has been far more important than that of expansion in area indicates that the process of growth has been technologically more dynamic too. While acceleration in yield growth, in recent years, has been significant for crops like Rice, Maize, pulses, Rapeseeds, Seasamum, Soyabean, Rubber and Cotton, for many other crops, yields continued to expand at the rates close to their pre-1981 levels. Again, unlike the past, enhancement in yield growth had been more impressive for non-foodgrains as compared to foodgrains and among the foodgrains for kharif foodgrains vis-a-vis the rabi foodgrains. This is an indication of a much wider diffusion of technology across the crops than in the past. Their study revels that the aggregate growth rate in agriculture has remained fairly stable and unchanged in the first two decades of the post green revolution period. again unlike the past, enhancement in yield growth had been more impressive for non food-grains as compared to food-grains and among the food-grains for kharif food-grains vis-a-vis the ravi food-grains.
An analysis of state level data on area and output of 43 crops for 30 years from 1962-65 to 1992-95 was carried out by Bhalla ans Singh (1997) and observed that there was a marked acceleration in the growth rate of agricultural output in India during 1980-83 to 1992-95 as compared with the earlier periods. Furthermore, agricultural growth had become regionally much more diversified. High labour productivity growth is likely not only to result in higher wages but also to trigger growth in non agricultural sector through input output and consumption linkages. They suggested that there is a need to give very high priority to investment in research and development and extension. Further, there are large potentialities in crop diversification and export and role of small and marginal farmers in this process cannot be underestimated.

In another study, Sawant et.al. (1997) noted distressing observation in Maharashtra agriculture that deceleration in the aggregate output and yield growth was accompanied by progressive increase in rates of expansion of many key inputs such as fertilizers, pesticides, electricity, etc. They observed that unfavourable rainfall conditions were only partly responsible for worsening of the growth environment during the 80's. However, crop pattern changes played an important role after 1981 in supporting the process of growth of crop output. Oilseeds were the major beneficiaries of these changes and were followed by other minor high value crops, pulses and sugarcane in descending order. A political commitment to promote investment for development of irrigation and other infrastructure and technologies for agriculture, without neglecting the development backlogs of various regions and districts within them is needed.

Another important study made by Bhalla and Singh (2001) noted the growth performance of Indian agriculture at the state level and district level during forty years of agricultural development covering the period from 1962-65 to 1993-95. Their study confirmed that the impact of new technology in transforming the traditional agriculture largely captured by North-Western India and Southern India. Whereas most of the rain fed states from central India and Eastern India failed to capture any significant changes in crop yield and crop output. According to them the growth rate of the value of output not only accelerated during this period it also spread to many states that had hitherto been left out. In the central region, many areas from Rajasthan and Madhya Pradesh, Northern Maharashtra and North Western states continued to grow at a respectable rate, nevertheless there took place a slight slowdown in their growth in the 1980s. In 1962-65
to 1980-83, the rapid growth in level of output took place only in the North western regions and coastal part of the southern region. However states from the central regions were all left out. It clearly comes out from the study that the spread of new technology was rather slow and halting during 1962-65 to 1980-83. But during 1980-83 to 1990-93, there was a significant acceleration in agricultural output due to extension of new seed fertiliser technology towards the eastern and central region and its consolidation in north western and southern regions. During 1980-83 and 1990-93, agricultural output record a growth rate of 3.47 % per annum as compared with 2.21 % per annum during the earlier 1962-65 to 1980-83. It further comes out that depicts a great deal of process, during 1990-93, 94 districts with 36.9 percent share in total area in India continue to be underdeveloped with very low yield districts are concentrated in Madhya Pradesh, Maharashtra, Rajasthan, and Gujarat in the central region and Bihar and Orissa in the eastern region.

In another study, Bhalla et.al. (2009) analysed the performance of Indian agriculture at the state level during the post reform period (1990-93 to 2003-06) and the immediate pre reform period (1980-83 to 1990-93). The authors showed that the post reform period has been characterised by the deceleration of the growth rate of crop yield as well as total agricultural output in most states. According to them, during 1980-83 to 1990-93, the crop output recorded an un-precedent annual growth rate of 3.40% compared with a growth of 2.40% during 1962-65 to 1980-83. But the post reform period 1990-93 to 2003-06 is characterised by a serious retrogression both in the matter of level and growth rates of yield and output in most of the states in the country.

Chand et, al. (2011) made an analysis on decadal trend growth rates to capture the effects of major changes in technologies and policies on the agriculture sector and understand the broad trend in growth. They estimated trend growth rate for 10 year periods by fitting a semi-log trend to the smoothened data. The study covers the period 1960-61 to 2010-11. Their analysis suggests that growth of the sector has been highly uneven across time and regions. The green revolution technology introduced in the late 60’s played an active role in lifting the growth trajectory from below 1% to 3% in the short time. However the post reform period witnessed a deceleration of growth in most of the major crops and this could be attributed to a significant diversion of resources away from agriculture.
2.4 Literature Review on Agricultural Productivity

Most of the studies that estimate agricultural total factor productivity in developing countries have found TFP to be declining even in the years which are well known for green revolution success arising primarily due to adoption of new and improved varieties of wheat and rice.

Kawagoe et al. (1985), using data for 1960, 1970 and 1980 in 21 developed countries and 22 less developed countries, estimate cross-country production functions for 1970 and 1980. They found that differences in production efficiency were small relative to differences in labour productivity among countries at a same stage of economic development but very large among different stages of development. Moreover, the large differences in total factor productivity between the developed and the less developed countries widened further between the 70’s and 80’s. They obtained the same type of conclusion by using an indirect production function and find similar results in that data set.

Fulginiti and Perrin (1993) estimate technical progress for LDCs for the period 1961-1985 using Cobb-Douglas production specification. The study reports technological regression for 14 of the 18 countries. It is possible, as suggested by the authors that interferences with the agricultural sector such as price policies had a depressing effect on incentives so as to stifle potential productivity gains. Fulginiti and Perrin (1998) use a parametric meta-production function and a non-parametric Malmquist index to examine the performance of the agricultural sectors in a set of 18 LDCs and find productivity regress in many of them.

Trueblood (1996) uses non-parametric Malmquist index and also estimates Cobb Douglas production function for 117 countries. The study also finds negative productivity growth in a significant number of developing countries.

Arnade (1998) estimates agricultural productivity indices using non-parametric Malmquist index approach for 70 countries during the years 1961-1993. It is found that thirty six out of forty seven developing countries in the sample show negative rates of technical change.
Kudaligama and Yanagida (2000), using deterministic and stochastic frontiers for 43 developed and developing countries over 1960, 1970 and 1980, indicate agricultural productivity for developing countries on a per farm basis deteriorated over the time period under consideration.

Nin et al (2003) estimate TFP growth for 20 countries during 1961-1994 using non parametric Malmquist TFP index with an alternative definition of technology sequential technology - and find that the earlier results reverse, and most of the developing countries experience productivity growth.

Coelli et al (2003) estimate TFP for Bangladesh crop agriculture for the period 1961-1992 using stochastic frontier approach and find a decline in TFP over the period (mean TFP change = 0.9537).

Rahman (2004) applies sequential Malmquist index approach to same dataset and finds TFP rising at the rate of 0.9% p.a and this growth is primarily led by those regions which have experienced high levels of Green revolution technology. Technical progress is found to be growing at 1.9% p.a that offsets declining efficiency at 1% p.a.

Alene (2009) estimates TFP in African agriculture for the period 1970-2004 using both contemporaneous and sequential Malmquist TFP index. The study finds that while the conventional Malmquist method estimates aggregate TFP growth to be a modest 0.3% p.a (most of the stagnation of TFP growth is explained by technical regress), using sequential Malmquist approach the TFP is found to be rising at 1.8% p.a.

There are a number of studies on the measurement of productivity that have been carried out for India as well. These studies pertain to agriculture sector and crop specific analysis. There are few estimates available of TFP changes at state-level.

Turning to studies on crop sector and crop-specific studies, Rosegrant and Evenson (1992) use Tornqvist-Theil index to estimate TFP change for Indian crop sector. They find rate of growth of TFP to be 1% for the entire period 1957-1985, 0.81% for the period 1957-1965, 1.22% during 1965-1975 and 0.98% during 1975-1985.

Kumar and Rosegrant (1994) estimate TFP growth for rice. They noted that the TFP index has risen by around 1.85 per cent annually in the southern region (Andhra
Pradesh, Tamil Nadu, Karnataka and Kerala), 0.76 per cent in the northern region (Haryana, Punjab and Uttar Pradesh) and 0.36 per cent in the eastern region (Assam, Bihar, Orissa and West Bengal). In the western region (Gujarat, Maharashtra, Madhya Pradesh and Rajasthan), the annual TFP growth was found to be negative but insignificant.

A notable study in this regard is of Fan, Hazell and Thorat (1998) which estimates TFP for agriculture at state-level using Tornqvist-Theil index for the period 1970-1994. The study finds that total factor productivity for India grew at an average annual rate of 0.69 per cent between 1970 and 1995. In the 1970s, total factor productivity improved rapidly, growing at 1.44 percent per annum, grew faster in the 1980s at 1.99 percent per annum. But since 1990, total factor productivity growth in Indian agriculture has declined by 0.59 percent per annum. The study also reports state-level estimates- for the whole period 1970 to 1994, the states with TFP growth rate in the range 0-1 percent per annum are Andhra Pradesh, Karnataka, Uttar Pradesh, Himachal Pradesh and Kerala; with TFP growth rate greater than one are Punjab, Bihar, Orissa, Maharashtra, West Bengal and J&K. The states with negative TFP growth are Haryana, Madhya Pradesh, Gujarat, Assam and Rajasthan.

Murgai (1999) uses Tornqvist-Theil Index to estimate TFP growth in Punjab at district level during 1960-1993. TFP growth averaged 1.9 percent from 1960 to 1993. Productivity growth in Punjab is found to be lowest during the green revolution years, even as farmers moved from traditional varieties of wheat and rice to modern hybrid seed varieties and the agricultural sector experienced high growth rates in production. The study attributes most yield improvements to rapid factor accumulation, particularly that of fertilizers and capital. Contrary to widespread belief, the contribution of productivity growth to economic growth is found to be small.


Rao (2005) uses Tornqvist-Theil index to estimate TFP changes for Andhra Pradesh across different crops for the period 1980-81 to 1999-2000. The study finds TFP growth rate for all the crops to be 0.23% in the pre-1990s period and -0.17%
during the post-reform period. The corresponding percentages are found to be -0.02 and 0.91 for foodgrains and 0.41 and -1.06 for the non-foodgrains. Kumar and Mittal (2006) estimate TFP growth across different states for paddy and wheat. They find TFP of paddy has started showing deceleration in Haryana and Punjab but TFP of wheat is still growing in these two Green Revolution states. About 60 per cent of the area under coarse cereals is facing stagnated TFP. Similarly, the productivity gains which occurred for pulses and sugarcane during the early years of Green Revolution, have now exhausted their potential.

Bhushan (2005) uses Data Envelopment Analysis to estimate Malmquist TFP index for major wheat producing states in India- Punjab, Haryana, Madhya Pradesh, Uttar Pradesh and Rajasthan. He finds TFP growth rate to be highest in Punjab and Haryana which is attributed to technical progress in these two states. Rajasthan (with no efficiency change) and Uttar Pradesh (with improvement in efficiency and negative growth in technological progress) have positive TFP growth rate while Madhya Pradesh (no change in efficiency and negative growth of technical progress) is reported to record negative TFP growth rate. As compared to 1980s, mean growth of TFP is found to be higher in 1990s and the primary source of TFP growth is technical progress and not efficiency improvements.

Bosworth and Collins (2007) use growth accounting approach and estimate TFP growth in primary sector for India to be 0.8% during 1978-2004, 1% for the period 1978-1993 and 0.5% for the period 1993-2004.

Chand et al (2011) estimate crop-level TFP for the period 1986-2005 using DivisiaTornqvist index. They find highest TFP growth for wheat crop. Except wheat and groundnut, TFP growth during 1986-95 is found to be lower than 1975-1985 in all crops and for several crops during 1996-2005. The percentage of cropped area for different states is distributed as per TFP growth rates and they find that the states of Punjab, Gujarat and Andhra Pradesh have highest TFP growth with 90% or more of cropped area having TFP growth more than 1%. Tamil Nadu, Haryana, Uttar Pradesh, Maharashtra have cropped area distributed across all TFP growth categories. The states of Madhya Pradesh, West Bengal, Bihar, Orissa, Karnataka, Kerala and Himachal Pradesh have larger percentage of cropped area reporting negative oragnate TFP growth.
2.5 Weakness of the Earlier Studies.

From an in-depth and extensive study of the existing literature on the measurement of growth, and efficiency in Indian agriculture, it has been observed that almost all these works suffer from a combination or all of the following weakness.

Firstly, the existing empirical literature in India has mainly focused on studying the secular time trend of the growth rate for different regions or India as a whole by using standard curve fitting techniques. The use of such techniques has failed to capture the possible welfare implications in the growth process in India.

Secondly, there has been an overreliance on the parametric methodology. However all parametric methodology depends on some assumptions that are difficult to sustain. Also though diagnostic testing for using such methods are used in the standard empirical exercises. In this regard, we have to consider non-parametric approach.

Thirdly, A few significantly low or high values at the end or beginning or middle of a short period may be responsible for high or low growth during that period. The estimated growth rate and its comparison from a similar type of observation may give a misleading idea about the performance of agriculture.

Fourthly, pointing out the limitations of summery measures of efficiency, most of the earlier studies based on the data of a few crops or a single crop. However, India is a vast and diverse country with wide ranging irrigational techniques and cropping pattern. In order to make a comparative study across the length and depth of the country, we require data on wide basket of crops that may be comprehensive and representable.

Fifthly, another misleading dimension in most of the studies in Indian agriculture is the relation between productivity, efficiency and technology. In the standard analysis productivity growth is often related to an improvement of technology and/or more doses of application of different types of inputs. Efficiency analysis opens a new door. It shows that the firm can use technology sub optimally. Consequently, output increase is possible even without a technological expansion and/or a scaling up of the inputs.
Sixthly, a variety of theoretical approaches, various methodologies, have been developed to investigate the failure of producers to achieve the same level of efficiency. However, all these studies failed to capture the welfare implication of efficiency in Indian agriculture.

In our study we have tried to cover up these research gaps apart from the consideration of different time period, different coverage and some new issues these are

1. We examine an important methodological study carried out by Kakwani (1997), who postulated some alternative growth parameters to implicate the welfare implications of the growth process in any country.

2. From the growth analysis following Kakwani’s (1997) growth we developed a non parametric approach of growth that would incorporate certain axiomatic foundation which has welfare theoretic implication.

3. Our study also analyse the farm efficiency of Indian Agriculture using Data Envelopment Analysis. The study is based on district level input output data of 35 crops on Indian agriculture.

4. Finally we have examined the possible trade-offs between growth in agricultural output and inequality and poverty to discuss the nexus between the efficiency and growth.

In spite of these unique features, our study can not avoid the inherent limitation. Due to non availability of adequate secondary data we have to restrict our study especially the growth analysis for only 57 (for Wheat it is 47) districts from three states -West Bengal, Maharashtra and Andhra Pradesh in India. For the same reason our analysis for efficiency analysis also restricted to 232 districts of India.