CHAPTER-2

REVIEW OF LITERATURE

2.1 Historical Survey:
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2.3 Studies on Measurement of Agricultural productivity:
2.1 Historical Survey:

The literature on the subject of agricultural productivity has several dimensions and in fact literature on the subject is very large. Here we reviewed some of the important works in the light of our objectives. We also examined the adequacy of these works from the point of view of our present investigation. Though our study has particular base in the Barak Valley, yet we considered the experiences and knowledge gained in some other areas of similar work.

Pandit (1975) has made a remarkable work on agricultural productivity in Uttar Pradesh. The broad objectives of this study are to see the trends in area, output and yield of the main crops viz. rice, wheat, sugarcane, etc. He analyzes the behaviour of prices and studies the supply response of rice, wheat and sugarcane and finally the work projects the future demand for food grains. He successfully furnishes the conclusion that agricultural development or an increase in agricultural productivity would lead to increase in the purchasing power of the rural poor and also help an increase in the growth of industries. He has also verified empirically that trends in area, production and productivity have direct bearing on agricultural development of the state. The study also finds that the productivity of rice, wheat, sugarcane, gram and maize increases both in area and production and productivity of barley and gram has declined. However the yield of the entire selected crop maintained an overall positive rate of growth estimating the cropping pattern of the state the author observes that percentage share of rice in gross cropped area remained constant at around 19 percent while in the case of wheat its increase was considerable. He also finds that agricultural productivity cannot be increased through horizontal expansion of land. Increase in agricultural productivity is possible only through the vertical expansion of land, by increasing area under irrigation, using chemical fertilizers and by increasing areas under HYV seeds. The study also reveals that in Uttar Pradesh the general price level is mostly influenced by the behaviour of agricultural prices. The degree of variability of prices of rice was however less according to his investigation. The study finally suggests the use of such farms which technologically keep land permanently under cultivation and which can be developed and used properly to increase agricultural productivity.
The study is not wholly applicable to our present purpose due to various reasons. Firstly, Uttar Pradesh is situated in a different climatic condition than Barak Valley. So those techniques which proves satisfactory in Uttar Pradesh may not be applicable in the present study. The study is based on the data of agricultural productivity of U.P. which in no way is similar to our present area of investigation. The author concludes that during the period under consideration (1951–1975) all the selected crops maintained a positive rate of growth, a very difficult proposition in the Barak Valley where several constraints in addition to flood always disturb the increase of agricultural productivity. The author also concludes that agricultural productivity can hardly be increased through horizontal expansion of land, where there is absence of any uncultivated land due to high population density. In Barak Valley on the contrary we find that there is the availability of low laying high lands locally known as tillas and uncultivated land, which if utilized properly may help to raise agricultural productivity. Thus in Barak Valley, not only the vertical expansion but also the horizontal expansion of land is possible. Thus the study is not wholly applicable in our present purpose.

Finally, Pandit argues that the general price level in U.P. is influenced mostly by agricultural productivity which is not wholly correct in the areas of south Assam. In this area it is observed that price level is influenced by many other factors. Lastly, the author made his study during the period of 1951 – 1975. But the economic condition not only in this area but also in Uttar Pradesh has changed with the lapse of time. These entire factors necessitate undertaking this special investigation relating particularly to Barak Valley, which has its own features and characteristics which are vastly different from the condition prevailing in Uttar Pradesh.

Sofi (1984) considers agricultural productivity or agricultural production as an important determinant in regional imbalances. He identifies the most important factor in locating the causes of regional imbalances and in diagnosing the process of increasing productivity or production. He studies the inception of intensive cultivation programme, the ground water resources, the problem of waste land
and finally examines the area production, productivity of thirteen crops available in Uttar Pradesh, in four categories viz. cereals, pulses, oilseeds and cash crops. He also studies the cropping pattern of these crops in terms of their rate of growth.

On the basis of the measurement of agricultural productivity he demarcates the productivity regions. He measures agricultural productivity in seven different methods and studies the difference arising out of the sensitivity of these methods. He then attempts to find out the best method for assessment of productivity and concludes that the method based on S N U (Standard Nutrition per Unit, output per hectare) is the best in measuring productivity.

He lastly fits the Cobb-Douglas types of function for input-output relationship in agriculture. This function depicts the relationship between inputs, like irrigation by canals result either in about 0.01653 present changes in low productivity regions or about 1082.14 S N Us where as whereas a change of 1% irrigation by other sources will bring a change either of 0.022 present in productivity or an additional production of 1458.36 S N Us. Again 1% change in the fertilizers anticipated a change of 0.1777 present in the productivity index or an additional output of 11,618.15 S N Us. Further he estimates that 1% change in labour will bring a change of (-0.9967) per unit in the net value of the productivity or an increased production of about 65,257.95 S N Us .The study therefore concludes that a change of 1% in irrigation by canal, 1% by other sources, fertilizers and 1% negative change in human labour bring an additional population of about 80 thousand persons in the low productivity regions of the state.

The study also reveals that 60% of urban and 70% of rural diet come from rice, wheat, pulses and potatoes. He also makes an assessment regarding future position and concludes that demand for foodstuff in relation to supply and in relation to population was discouraging in respect of rice and pulses till the end of this century. His estimate reveals that in the case of rice, the shortage will be about 0.5 million tonnes in 1995-96 and 4.2 million tonnes in 2000-2001 for the state as a whole.
The author then makes an attempt to suggest possible ways of reducing regional imbalances in regard to productivity. He suggests that in order to reduce regional imbalances in productivity, efforts should be made to raise the productivity of the low and medium areas at par with at least medium and high productivity regions.

The study though brings into limelight the actual position of the state of Uttar Pradesh in the field of rice and other agricultural crops, yet it is not wholly applicable to our present purpose due to various reasons. Firstly, Uttar Pradesh is situated in a different climatic condition than Barak Valley. So, those techniques which prove to be satisfactory in Uttar Pradesh may not be applicable in the present study. Secondly, the author considers only thirteen crops, and doesn’t consider the other crops. Therefore, the study has its limited applicability. All these factors necessitate undertaking this particular study relating to Barak Valley which is vastly different from Uttar Pradesh.

Bhau (1990) considers the impact of chemical fertilizers on agricultural productivity. According to him, in-spite of the availability of labour and other inputs of agriculture, marginal productivity is very low and sometimes zero. He therefore attaches Indian agricultural development to the levels of technology used in the process of production. It is because of this that India doesn’t have sufficient opportunity to invest in modern inputs such as fertilizers, HYV seeds etc. The author considers only the impact of chemical fertilizers on agricultural production.

The author observes that Indian farmers are ignorant about the optimum doses of fertilizers of a crop and for that matter they don’t use optimum doses in the production of crops. However very few farmers have such knowledge of optimum doses of fertilizers, yet they do not use them in optimum quantity. Many factors are responsible for these two cases. In the first case, factors responsible for less use of fertilizers are carelessness on the part of the farmers, inadequate and improper guidance by the concerned department, lack of co-ordination between farmers and the concerned department, illiteracy on the part of the farmers and so on .The factors responsible for the second category i.e. in-spite of
adequate knowledge why farmers do not use fertilizers, according to the author, are, lack of purchasing power on the part of the farmers, lack of credit fertilizers, higher cost of fertilizers and improper distribution of fertilizers etc.

The author observes that due to the lack of knowledge, farmers do not apply fertilizers at proper time. More doses knowingly or unknowingly are applied by some at proper time, whereas the remaining doses are not at all applied. The medium and small farmers use only up to second doses, while medium and large farmers use up to last and third doses of fertilizers. The reason behind this, according to the author, are lack of knowledge on the part of the farmers, malpractices on the part of the co-operative dealers, irregular supply of fertilizers, lack of credit fertilizers etc.

Finally, the author makes an attempt to study the relationship between fertilizer consumption and its impact on various outputs and finds that in the case of all varieties of wheat the relation is positive, in the case of oilseeds the relation may either be positive or negative. This clearly indicates that in the case of oilseeds fertilizer is the least significant factor. In the case of rice also it is difficult to establish whether the relation is positive or negative. This is also due to fact that rice output depends largely on other factors, rather than on fertilizers’ production decreases.

Lastly, to increase consumption of fertilizers the author suggests avoidance of artificial scarcity, fair distribution, reasonable price level, soil testing etc.

The study no doubt is successful in achieving its objectives viz. to study the possible effect of chemical fertilizers on output, yet not whole-heartedly acceptable. India is a land with diverse characters of soil, irrigation facilities and such other factors which mainly govern agricultural production. The author considers only the fertilizers. Therefore changes in production and productivity may not be wholly dependent on the function of fertilizers.

Further, there are infinite varieties of products produced all over the India; the author considers only the selected few. The reason put forward by the author
for less use of fertilizers or improper use of fertilizers etc. are no doubt true, yet along with these factors, there are some other factors such as attitude of farmers and the like which the author doesn’t foresee. Due to these reasons the study loses its significance.

Munir (1992) has considered the effects of agricultural productivity on Development based on the data from the district statistical bulletins and information from district statistical offices of a few districts of Uttar Pradesh, covering a total area of 26,356 sq. k. He has gone to identified areas of high and low agricultural productivity, to delineate regions, at varying levels of development and to examine the relationship between agricultural productivity and levels of development.

According to him agricultural productivity varies from place to place. The natural factors such as rainfall, soil etc. are less significant. The other such factors as pattern of cultivation, quality of seeds, fertilizers i.e. those which are non-environmental in nature contribute more to variation in agricultural productivity in different areas or regions. He finds that regions having high initial income or productivity are technologically more advanced and have a land use pattern which is conducive for further increase in agricultural productivity or income. He also finds that the regions having higher productivity have the initial advantage of agro-based industrialization, which also contributes in augmenting agricultural productivity. Further he has observed that agricultural productivity is not the unique factor leading to variation in development among regions. Some other factors such as urbanization and modernization are among other things causing developmental variation.

The relation between agricultural productivity and levels of development are found to be positive according to the study. This clearly indicates that agricultural productivity among other factors contributes to a great extent in the regional development.
Agricultural productivity provides the base for industrialization and business activities as he finds that all these factors are developed in the areas of high agricultural productivity.

The study also reveals that low productivity and hence the resulting backwardness of the regions is mainly due to the lack of commercialization of agricultural productivity according to the author. This will help to increase production of commercial crops and thereby help in the process of industrialization. The excess of output or income produced due to commercialization of agriculture, if reinvested in agriculture in the form of modern inputs, may increase agricultural productivity. Financial assistance to agriculturists is considered as an equally important factor to increase agricultural productivity. Large scale unemployment of rural agricultural people increases the pressure of population on land and thereby labour productivity declines. Establishment of cottage and household industries in the rural areas is a solution to this problem according to the author. This will help in increasing productivity.

The study is interesting in so far as it attempts to focus on the factors of urbanization and modernization. However the views of the author are contradictory as he assumes that the initial level of high income and already high productivity can trigger off higher agricultural production, whereas he also maintains at a later stage that higher agricultural productivity leads to urbanization and modernization. As a result one fails to understand the cause and effect relationship of the variables under investigation due to which the study loses much of its significance.

2.2 Existing Literature:

Many scholars have discussed various aspects of agricultural development of different regions from time to time. The attempts made so far have captured the economic relations and responses in the agricultural sector. The institutional character, technical concerns, productions relations, marketing network are some of the measure areas highlighted by the scholars. The interaction between agriculture and economy and other sub-sectors of the primary sector have also
been touched upon. In fact, these relationships influence the pattern of production and productivity.

Agricultural productivity in practice is an elusive term and its measurement is a difficult job. Many experts in the field of agricultural economics have long been engaged in determining and measuring agricultural productivity in different parts of the world. They also worked on delimiting the weaker areas for understanding problems and formulating development programs for the same. They used different variables to compute the productivity and evolved some methods.

Sen (1962) in his paper stated a proposition based on Farm Management Surveys (FMS) that, by and large, productivity per acre decreased with the size of holding. Thus, maintained Sen, productivity was more on small farms as compared to large farms. Although Sen himself expressed some cautions regarding the statistical basis of the proposition concerning this inverse relation (especially in his subsequent paper of 1964), the phenomenon was taken to be more or less well established by most economists who proceeded to provide a number of alternative explanation for the observed tendency.

Krishna (1964) found that the same farm management survey data on which most of the empirical work was based would support the finding that holdings between 13 and 16 acres yield both the maximum and minimum output per unit of input cost.

Rao (1968) pointed out that the results obtained by Rudra were perhaps due to the use of yield per gross cultivated area (Gross cultivated area or the size of farm multiplied by intensity of cultivation) to the extent that the intensity of cropping varied systematically with size (particularly if inversely). Rao argued that Rudra’s formulation would be biased towards eliminating the inverse relation between size and yield per acre.

Bhattacharya and Saini (1972) used disaggregated FMS data for individual forms. Separately for each sample village, and applied statistical tests for examining the relationship between farm size and gross value of output per acre.
They considered two districts, namely, Muzaffarnagar in U.P. and Ferozepur in Punjab. The results obtained by them in their own words are as under:

“The negative correlation between farm size and productivity is, therefore, clear for this region (Muzaffarnagar) in the sense that such correlation is observed within most of the sample villages and could not have arisen due to aggregation over villages.”

Clelland (1974) measured agricultural productivity in India by the output per unit area of leading individual crops in the districts. Sharma and Coutinho (1974) have investigated the dynamism in area and productivity per unit area in Jowar in Karnataka. The author has correlated the changes with the changing socio-economic variants and has highlighted the regional imbalances in the level of Jowar productivity.

Hussain (1976) converted the agricultural production into the whole region. Thus the higher the money return per unit of area higher is the agricultural productivity. Money returns are calculated per unit of area or even per head of agricultural worker (including the cultivator and agricultural labourer). It should be mentioned here that the money value coefficient does not take into consideration the value of the byproducts of the crops.

Abhalakshmi (1978) discusses elaborately about the food problem of India, in her language, ‘to solve the food problem of India, the most suitable strategy seems to be to increase the production per unit area, per unit time, because the scope for bringing more areas under the plough is very much the limit of physical frontiers in cultivation. The percentage of cultivated area in the country is 45.6, which is highest in the world. Moreover, to bring more of marginal lands under cultivation will need heavy investment on land leveling, soil conservation, land reclamation, etc. which can be justified only on the basis of ‘cost benefit ratio’.

Bhalla (1979) observed that the inverse relationship between farm size and productivity is a reflection of substantive differences between small farm size and large farms, rather than a product of sample selection bias or village factors correlation with farm size.
Berry and Cline (1979) contains examples of total factor productivity analysis, and the results seem to confirm the inverse relationship for overall farm efficiency.

Singh (1981) while conducting study on “Imbalances in Agricultural Growth” found that an uneven growth rate of individual crop has led to the regional imbalances in the rural prosperity. Rice is the main cereal crop in most of the states. Even in this crop also the growth rate has not been uniform in the different states. Agriculture is the main income generation factor in rural India. There is an evidence of imbalance in growth which led to imbalance among the regions and states.

Pinstrup-Andersen (1982) clearly states about agricultural production. The low agricultural production problem in developing countries consists of low productivity levels for land and labour and a small agricultural production with limited increase. These elements are interrelated.

Mishra (1982) states that in the wake of technological transformation in the rural areas, the greater intensity of input package demands higher investment. The increasing demand for credit from all sources becomes encouraging in view of the impetus given to the process of transformation from primitive agriculture to commercialized agriculture.

Hanumanta (1983) emphasizes for more credit to the small farmers at a lower rate of interest. He, further, stresses the importance of credit and, thus, opines that land and labour have ceased to be the predominant factors of growth in Indian agriculture. Capital, together with scientific knowledge, has already become a major source of growth and its significance is rapidly increasing! The disparities in income and in wealth, within the agricultural sector would, therefore, depend on how capital is and will be distributed among different holding size groups. Credit from institutional sources (that is, cooperatives, government and the nationalized commercial banks) has become increasingly important as a means of capital formation in agriculture”.

Rao (1983) says, “Credit is the life blood of any programme”.
Grewal and Rangi (1983) made an attempt to estimate the growth of Punjab agriculture in relation to productivity increase and response to the use of fertilizer and observed that productivity increase was largely the outcome of increased irrigation and fertilizer use. It was further estimated that one kilogram of fertilizer nutrients yielded about 8 kg of wheat grains during the period 1967-68 to 1976-77 when the average use of fertilizer for wheat crop was about one-third of the recommended dose. During the succeeding period ending 1981-82, this response was only 5.6 kg of wheat per kg of fertilizer nutrients applied. This was the case when fertilizer use was two-third of the recommended level.

Sirohi et al., (1983) while conducting study on “Trend of Agricultural Productivity and Production in India”, did not support the view that the trend in foodgrain production or total agricultural production has been stagnant or has declined, during the recent period. They examined the trend of production and productivity of wheat per hectare which has significantly increased during the study period, i.e., 1970-71 to 1981-82. The productivity of some crops like bajra, pulses and gram has been stagnant or has decreased slightly. Crops like rice and cotton have shown a rising trend. The productivity of total food grains per hectare has also increased during recent years mainly due to rise in the productivity of wheat crop. The study also indicated that the yearly fluctuations in agricultural productivity and production were so large that they completely overshadowed the general trend of rise and fall of productivity and production.

Ganguly (1984) clearly explains the marketing problem of farmers, in his language, “Marketing of goods also requires skill and holding capacity. The farmer in the region is weak on both fronts. Generally, a large percentage of agricultural produce in its unprocessed form comes to market immediately after harvest, which causes a slump in the market due to a low price. The farmer loses a considerable portion of the consumer price by selling his produce immediately after harvest. As we have noted earlier, the farmer is forced to do so because he is in urgent need of cash.”

Prasad (1985) argues that land reform in the sense of 'land to the tiller', is the one measure that is needed for an enduring solution of the problem of rural poverty.
Land reform is needed to break the power of the rural oligarchy and initiate the process of rapid agricultural development. The other solution lies in providing water management, fertilizer, HYV seed and extension service in a big way, for rapid agricultural development.

Agrawal (1986) emphasizes on the price of agriculture products, which determine farmer’s incomes. In his language, “Since the outcome of any scientific research is uncertain with break through arriving at irregular intervals, the best course of action available for the present is to make the most of the available technological knowhow. To do the same in the agriculture sector of Assam, it would be necessary to strengthen the agricultural infrastructure both qualitatively and quantitatively. In particular, it would be necessary to improve irrigation facilities, agricultural extension service and the flow of institutional credit to the farm sector”.

Bhat et al., (1986) made an attempt to study the growth rate in production of major crops in Jammu & Kashmir state for the period 1970-71 to 1983-84 and found that the compound growth rate of 4.85 per cent followed by rice and wheat with 1.85 and 1.19 per cent respectively which had been observed to be significant at one percent level of probability. However, the compound growth rate of area under pulses indicated non-significant trend, i.e., 0.30 per cent but the compound growth rates of production were found to be highly significant in the case of rice (3.80 per cent), wheat (2.78 per cent) and oilseeds (10.01 per cent).

Ajit (1986) expresses similar opinion on the roles of credit. The change in the outlook of the bankers towards “Poverty focused programme for the Underprivileged” was considered crucial.

Desai (1986) elaborately explains on the drawbacks of the agricultural marketing. In the present condition of agricultural marketing-on the whole, though some improvements are taking place in agricultural marketing, there are lakhs of farmers living in thousands of districts or isolated villages who face all types of difficulties in marketing their surplus product.
In the first place, a majority of agriculturists are illiterate, poor, without much holding powers, without proper storing facilities, and without any or much knowledge of market conditions. For example, storing facilities in the case of most small farmers are so poor that nearly 5 to 10 percent of stored grain or even more is likely to be eaten away by insects or rats.

**Singh and Gangwar (1986)** made an attempt to examine “Trends and Variability in Area, Production and Productivity of Coarse Grains and Pulses in Haryana” for the years 1966-67 to 1980-81” and found that the growth rate of the area under green gram and lentil declined at the rate of 10.67 and 2.66 per cent per annum respectively which were found to be statistically significant. The area under gram and black gram also declined at the annual rate of 1.65 and 0.18 per cent, respectively. There had been an increase in the yield of Jowar and barley at the rate of 1.10 and 1.60 per cent per annum respectively. The yield of maize declined at the rate of 1.19 per cent per year followed by bajra (1.05 per cent) which was statistically non-significant. The yield of green gram, black gram and lentil increased while the yield of gram declined but it was non-significant. The yield of green gram, black gram and lentil had growth at the rates of 6.9, 4.7 and 2.3 per cent per annum respectively. The productivity trend of pulses was near zero indicating stagnation in the yield of total pulses.

**Prasad (1987)** in “A Study on Trend in Area, Production and Productivity of Pulses in Bihar” during 1960-61 to 1989-90 reported that in the area, production and productivity of gram and lentil were consistently higher in Zone III, while that for arhar they were higher in Zone I. Growth rate analysis indicated that the compound growth rates of area and production of pulses had, by and large, declined all over the state, except that for production of gram in Zone VI, production of arhar in Zone V and production of lentil in Zone I. A positive growth rate in area was found in lentil only in Zone II and Zone IV. Productivity of all the pulse crops under study had positive growth in all the zones of Bihar during the period under study. The factors like rainfall and area under irrigation had significantly affected the production of pulse crops only in some of the districts of the states.
**Bhatia (1988)** explains about the food problem of India, about India's response to the grave food crisis that the country faces in 1965. The crisis was long standing. Earlier, Jawaharlal Nehru had said: ‘Every Thing else can wait but not agriculture.’

**Date and Pawar (1988)** worked on agricultural productivity: A micro level study of two villages (Maharashtra). Authors studied the association between productivity of four selected crops and soil characteristics and economic factors at micro level. Soil samples and related data were collected from Bhadalwadi and Kuravli villages differing in physical and economic aspects. Authors used 16 variables and finally correlation and multiple regression techniques were used in order to measure the significance of the variables and their associations with productivity of four important crops grown in both the villages viz. Jowar, bajara, wheat and sugarcane.

**Raman, Anwer & Gaddagimath (1988)** express the technical difficulties of farmers. It is indeed a cause of concern that although new cultivation has very high yield potential the same is yet to be realized at the farmer’s fields. There exist very large gaps between what we are able to demonstrate at the agricultural experiment station and what we are able to achieve at the farmer's fields. This gap ranges from 25% to 80% in various parts of the country. The need for reducing this yield gap need not be over emphasized.

**Desai (1988)** explains regarding drawback of agricultural finance. He elaborately explains “Finance is a vital factor of production function, more so in agriculture where the prospects of 'plough back' are weak, compared to trade and industry. Agricultural finance plays a catalyst role in promoting agricultural development”.

**Gadgil (1988)** shows that the imperative of institutionalization of rural credit is also reflected in the article entitled “Agricultural credit in India: A Review of performance and Policies”. He asserts the importance for “Credit widening as well as credit deepening” for more production and subsequently, rural prosperity.

**Bhalla and Tyagi (1989)** study, which extended the period from 1970-73 to 1980-83, also brought out some interesting conclusions. Firstly, it was found that
with the passage of time, the new technology had spread to new areas during the eighties. One of the important developments was the introduction of High Yielding Varieties (HYV) rice, mainly IR8, not only in the assured irrigation areas of the north-western states as a second crop but also for the first time in the southern state of Andhra Pradesh and to some extent in coastal areas of Tamil Nadu. Secondly, the study confirmed that the growth performance of rainfed areas was characterized by the persistence of very large inter year and inter-period disparities. The rainfed areas which had shown poor performance during the first period 1962-65 to 1970-73, recorded very high growth during 1970-73 to 1980-83 as a result of good monsoons. But the states in the eastern region continued to experience low growth even during this period. Third, the district level analysis also confirmed that with the passage of time the new technology spread to newer areas and encompassed more districts thereby leading to higher output growth rates. The growth of output enabled many low productivity districts to graduate to mid-productivity level and many mid-productivity districts to move to the high productivity category. Thus whereas the number and weight in terms of share in GCA and share in value of output of low productivity districts went down, that of high productivity districts went up.

Mali (1989) explains the relationship between the development of agriculture and industry. In his language “Agricultural sector forms the base for the development of any economy. Industrialization of an economy might be an ultimate goal, but agricultural sector provides the necessary basic network for Smooth Industrialization. Immediate increase in the level of agricultural productivity and income is not only a Social necessity but paves the way for industrial orientation and healthy environment needed for industrial development”.

Bandyopadhyay (1989), while conducting a study on “Growth and Instability in the Production of Main Cereal Crops in West Bengal and Punjab-Haryana”, reported that the elaborate network of irrigation in Punjab-Haryana, independence of the vagaries of the monsoon/rainfall along with the development of private tube well irrigation on a substantial scale, particularly during post-green revolution period, may have effectively narrowed down the year-to-year
fluctuations in the production of wheat. Rice crop has also been introduced in the states which grew at a much faster rate compared to that in West Bengal. Irreparable damage done to the ancient irrigation network in Bengal during the colonial rule on the other hand, has not been compensated by the development of irrigation during the era of planned development since the independence in West Bengal. Irrigation has been the main technological constraint for agricultural production in West Bengal.

Singh (1989), in his study on “Agricultural Instability and Farm Poverty in India”, used the coefficient of variation statistics along with the time series data of major crops for the period 1971-1986 and observed that the yield variability in the case of rice crop was the highest, i.e., 29.14 per cent for Punjab followed by the states of Rajasthan, Utter Pradesh, Andhra Pradesh, Orissa, Gujarat, Bihar, West Bengal, Himachal Pradesh and Jammu & Kashmir. It was the lowest, being 6.11 per cent, for the state of Assam. It may be noted that the states having the highest yield variability were found to be having the highest average yield per hectare. The higher average yield and higher yield variability in the case of non-traditional rice growing states are due to intensive cultivation and increasing area and yield of rice. In the case of wheat, the states having higher yield variability had lower average yields in general. Hence, it may be said that the wheat is a more assured and stable crop than rice. Mazie crop showed the highest yield variability, i.e., 41.66 per cent in Tamil Nadu, followed by Gujarat (33.11 per cent), Maharashtra (30.33 per cent), Rajasthan (29.14 per cent), Utter Pradesh (28.16 per cent) and Andhra Pradesh (23.61 per cent). It was the lowest in Assam, being 3.82 per cent. However, this crop showed some variability in the states having higher average yield per hectare. There was not much inter-state variation in yield variability of gram. The major cotton growing states such as Punjab, Haryana, Gujarat, Tamil Nadu and Rajasthan showed greater yield stability. In the case of sugarcane, the states like Tamil Nadu, Maharashtra, Madhya Pradesh, Karnataka and Andhra Pradesh showed the stability in sugarcane production because of having lower value of coefficient of variation and comparatively higher per hectare yield.
Reddy (1990) assessed that the Green Revolution has contributed to higher growth in crop production in Andhra Pradesh, but it widens the inter-regional disparities and intra-regional disparities in agricultural growth. The cross section regression coefficients of irrigation, total cropped area and rainfall (explanatory variables) recorded negative signs, implying that the irrigation and rainfall contribute to stabilize fluctuations in production and yields. The study also supports the view that irrigation and rainfall contribute to stabilize the production albeit to a limited extent as the signs of the regression coefficients are negative but still, do not fully account for the variations in both production and yields.

Rajkumar (1990) explains about the importance of agriculture sector like this, “The importance of agricultural Sectors lies in various fields of the economy. It is a source providing food articles to feed people. It has a share in the country's export and is the source of raw material for various industries, such as, jute, textile and sugar, etc. Further, a major part of the country's population and labour force country's their livelihood and earnings”.

Shankar Rao (1991) expresses his views regarding the role of the agricultural sector as a base of the development of the nation in his book “Integrated Rural Development and Area Planning in India”. Regarding the economy of Assam he states like this; “As the tremendous potential water resources of the Brahmaputra and Barak are not manageable to proper use for profitable purpose, it goes berserk in every rains devastating the State and the state has been experiencing an annual loss of Rs. 250 to 300 crore worth natural wealth and crops. This has also necessitated undertaking of relief, rescue, rehabilitation and repair work, to the extent of Rs. 500 to 600 crore every year”.

Chattopadhyaya (1991) in his study broadly suggests that during the last three decades West Bengal’s rice economy was subjected to technological changes with positive effects on area, yield and production of rice. It cannot be said to have been stagnant over these years. But, it has also been uneven spatially (in the districts) and temporally. The diffusion of the new technology is widely at variance among districts and seasons. Increase in variability accompanied the growth of yield and output, thereby increasing the risk of rice cultivation which
limits the acceptability of the technology among the risk of rice cultivation which
limits the acceptability of the technology among the risk minimizing farmers. The
yield variability seems to be related positively to rainfall variation and negatively
to increase in irrigation and fertilizer application. However, the relation is not
very clear.

**Pal and Sirohi (1991)** made an attempt to study the adoption of HYV seeds and
growth and instability in crop production in India and reported the changes in the
base (mean area and mean yield), yield variability and simultaneous instability
(variance). The relative instability in wheat cultivation declined in more irrigated
areas. The larger contribution of interaction terms indicates the production
instability. Individual, yield variability was an important source of instability in
most of the crops. The changes in yield might have caused the changes in area
and this led to higher area-yield co-variability. The cultivation of HYVs in less
endowed area and extension of cultivation to marginal and sub-normal land might
have caused higher production instability. This problem was more apparent in
course cereals, pulses and oilseeds. Therefore, it could be concluded that the
interplay of agro-climatic factors and new technology led to increase in
production instability in India and HYVs can be held partially responsible for
this.

**Vaidyanathan and Mukherjee (1991)** in their study on “State-wise Functional
Analysis of Agricultural Growth” during the Period 1952-53 to 1976-77, reported
that the proportion of variation in total food grain output explained by the model
ranges from 62 to 94 per cent. It exceeds to 80 per cent only in 5 cases out of 12
considered. While judging the strength of the model, it needs to be borne in mind
that the data has both gaps (e.g., irrigation in Orissa and West Bengal) and errors
(sampling and non-sampling ones in yield ones in yield estimates) and hence
assumptions had to be made in constructing series on fertilizer consumption.
Under these circumstances, very high R2 would indeed be rather doubtful.
Rainfall and trend explains more than 80 per cent of the area variation in 9 out of
the 12 states. Rainfall contribution to the area variation is high, precisely in those
states where the overall explanatory power of the model is land.
Venkata Rao (1991) conducted a study on the production of 22 crops in the North-Eastern region and revealed that for major crops like rice, other pulses, rapeseed and mustard, sugarcane, etc., stagnancy has set in. There is an accelerating trend in the production of potato and relatively minor crops like tur (red gram) and groundnut. On the whole, principal crop groups exhibited low fluctuations in yield per hectare. The major contribution to the growth of crop output in agriculture came from area expansion. The contribution of yield increase was only one-third and the changes in cropping tended to lower the growth of crop output in the entire north-eastern region.

Ramakrishna (1992) has observed that agricultural output registered 2.69 per cent growth rate per annum during the period from 1950-51 to 1990-91. Similarly food and non-food grains registered 2.71 per cent and 2.76 per cent growth rate respectively during the same period. The increase in the growth rate of agricultural output is mainly due to an increase in area (1.92 per cent growth rate) in fifties and due to productivity increase in the later periods (1.61 in sixties, 1.72 in seventies and 3.25 per cent in eighties). Hence, productivity is the main contributor to agricultural output growth than area during the study period and its growth rate was also high in post-green revolution period. He also found that there is a positive association between fluctuations and agricultural productivity, but the same association cannot be attributed to production and area.

Jha (1994), while conducting study on growth and instability in agriculture associated with new agricultural technology during 1972-73 to 1990-91, found a decline in yield instability in gross return and yield over years. The decline in yield instability in crops, viz., paddy and wheat was brought about with increased area under irrigation over the years. Nevertheless, the government’s consistent price policy also helped in the reduction of instability in farm harvest prices. Thus, it has been inferred that with new technology, instability in agricultural income reduced with adequate irrigation facilities and consistent price policy. However, the hypothesis of high instability in agriculture accompanied with high growth rate was established.
Glaesar (1995), however, suggests that the impacts of irrigation systems, particularly of canal irrigation are besieged with a number of environmental problems. Subsidised canal irrigation and subsidized electricity for tube-wells, remunerative output price support, availability of HYV’s and higher returns encouraged the farmers to opt for water intensive crops. Cases of rise in the water table and said salinity in some command areas of Punjab, Haryana, Uttar Pradesh, Maharashtra, Gujrat, Tamil Nadu and Andra Pradesh have been reported due to inadequate provision of drainage and shift in the cropping pattern in favour of water intensive crops like rice, sugarcane and wheat.

Gulati (1995) suggests that the adverse effects of irrigation induced soil salinity and water logging are evident at the farm level in the form of decline in crop productivity, reduction in input use levels, restricted choice of crops, land abandonment and low farm income. Also investment in major irrigation projects has a long gestation period and it takes considerable time before direct production impacts start appearing.

Moreover, the economic gains from surface irrigation in many projects do not commensurate with the large public investments and subsidy given to the farmers.

Damodar Reddy, N (1996) found that the traditional agricultural of the district was capable of dynamic growth impulses in respect of the traditional crops. He found that there is no clear evidence for intensified adoption of HYV seeds in the selected crops and also for the impact of HYV seeds on the productivity of selected crops in Mahaboobnagar District.

Prakash (1998) observed that modern farming is based upon the principle of industrial production, that is, more the inputs, more the production. The need to increase agricultural production has led to a reckless use of water, fertilizers and pesticides which in turn have increased the toxic constituents of crop and soil besides degrading the land.

Sharma (1998) examined recent trends in area, yield and production of cereals in Karnataka. The author analysed the changes and trends in the area, yield and
production of cereals for the period 1966-90 at the state level and then examined in depth the situation in the four homogeneous regions of the state using taluka and the district level data. The author concluded, based on compound growth rates for the two periods of 1966-90 and 1980-90 for trends and coefficients of variation for 1966-90 for year to year variable.

Pochanna (2000) has observed that the association between yield growth and instability shows a negative direction at the national level and in most of the states. He observed the positive association between yield growth and instability in Punjab, Haryana, Andhra Pradesh, Karnataka, Orissa and West Bengal. He found that the use of Fertilizers and spread of irrigation facilities are important factors not only to yield growth but also to reduce the fluctuations and ensure stability in the yield growth.

Patil (2000) worked on changes in Agricultural productivity in Upper Bhima and Upper Krishna Basins in Maharashtra: A Geographical analysis. The author selected six variables i.e. Kendall's Ranking Co-efficient, Bhatia’s productivity Index, Agricultural productivity based on standard nutrition Units, based on the total number of calories available per person, money value method and Enyedis (1964) method. Aggregate productivity was calculated for the study region and productivity regions were demarked by using six variables. This is done for each of the three years of 1985-86, 1990-91, and 1996-97.


Krishnan (2001) describes the drawback of the agriculture economy, like this, “Prices of agricultural produce are important for farmers as these determine their
incomes. Buyers are no less affected by these prices be they consumers, industries or exporters. As incentives for raising production and a rational allocation of resources, as also for acquiring marketable surplus, there is the social interest involved in these prices! It is therefore of considerable significance that we have such a level and structure of prices that satisfy all these varied aspects of the economy”.

Rao (2001) tried to study the impact of World Trade Organisation (WTO) on viability of Indian agriculture in which, he explains the main rationality of introduction of WTO and whether Indian agriculture reaped the benefits in the post globalisation period. He argued that India could not exploit the trading opportunities with comparative cost advantage due to high domestic support, export subsidies and denial of market access through various tariff and non-tariff barriers in the developed countries. The major challenge to the viability of agriculture of India is posed by the shortfalls in public investment and the provision of agricultural services account for the failure of agricultural supplies to respond to the favourable incentive framework created by macroeconomic reforms, including trade liberalisation, in the 1990s. India was a major exporter of food grains in the world but due to the unfavourable terms of trade, exports have come down and finally, the price fall in the international market has significantly affected the whole farming community.

Roy and Pal (2002) conducted a study in India to analyse the impact of agricultural investment on agricultural productivity and rural poverty. They observed that agricultural productivity growth is central to alleviating poverty and infrastructural and technological changes are, in turn central to this process. This requires not only a change in institutional policies but, also enhancement of public and private investment in agricultural research, rural infrastructure including roads, marketing, storage and irrigation. They pointed out that investment is a better instrument than subsidies in agriculture and whatever subsidies to be provided it should be targeted to the poor and backward regions. The role of human capital and agrarian reforms are critical, as these have direct and indirect effect on agricultural productivity and rural poverty. They further
suggested that in view of financial austerities of government, incentives to farmers should be improved to enhance private investment in agricultural sector.

Anonymous (2003) in the “Indian Agricultural Policy: Vision 2020”, stated that the public investment in agriculture has been declining and was the main reason behind the declining agricultural productivity and low capital formation in agricultural sector. Private investment in agriculture has also been slow and must be stimulated through appropriate policies. Accelerated investment is needed to facilitate agricultural growth and rural development.

Chand and Kumar (2004) studied the impact of capital formation on Indian agriculture and it is found that growth in capital formation is significantly related with growth of agriculture. But capital formation in Indian agriculture has been either stagnating or falling since the beginning of 1980s but macro-economic reforms further squeezed public investment, though there is rise in private investment that was not rising to meet the requirements.

Adnaik (2005) worked on spatiotemporal changes in Agricultural productivity in the Drought prone Region in Maharashtra state. He selected eight variables i.e. Kendall's Tanking co-efficient, Bhatia’s productivity index, Agricultural productivity based on standard Nutrition units, Enyedi’s productivity index, Shafi’s modified index, based on calories per capita, Sapre and Deshpande's index and based on Aggregate productivity index was calculated for the study region and productivity regions were demarked by using eight variables. This is done for each of the two years of 1985-86 and 1998-99.

Vakulabharanam (2005) argues that the state had offered various input subsidies, especially in the provision of fertilizers, electricity and credit. It had provided infrastructural support (primarily in irrigation and electricity) and extension services to cultivators. It had also provided minimum support prices for agricultural output. The policies after 1990, unevenly withdraw this support to the farming community. The reduction of domestic support in terms of subsidy and credit on the one hand and drastic price fall of agricultural commodities in the international market on the other hand led to distress in the farming class.
Patnaik (2005) tried to identify changing agrarian situation after reforms. This study tries to explain how neo liberal policies introduced in the 1990s affected peasant community by examining the fund allocation to the rural development from the Net National Product. Fund allocation to the rural development will result in improving irrigation and other heads of agriculture and this fund allocation has come down from 4 per cent of NNP to 1.9 per cent of NNP by 2001-02. The study also explores the impact of liberalization on food security and found out that shift in cropping pattern towards nonfood grains has led to food security problem. Since advanced country markets were in recession and global primary product prices went into a steep tailspin with 40-50 per cent decline in unit dollar prices of all crops –cereals, cotton, jute, sugar, tea, coffee – and up to 80 per cent decline in some oil crops between 1995 and 2001. With a brief spike in 2002 most prices have continued to fall and some prices are today lower than as far back as 1986. This resulted in the distress of farmers which had led the farmers to commit suicides.

Galab and Reddy (2006), the authors, precisely talked about the factors that caused crises in agriculture. They are technological factors, ecological, socio cultural and policy related factors. Extensive cultivation has led to decrease in fertility and productivity. This is also because of intensive use of fertilizers, since the input intensity is increased in the marginal farms the productivity fell down, coupled with the increasing cost of inputs. These factors ultimately led to decrease in profit margins. Ecological factors include decreasing quality of land and water resources due to intensive chemical and fertilizer use. Socio cultural factors include the effects of globalization and urban culture on villages which had shown impact on health and education consciousness in the rural agrarian families. In order to get the access of better facilities farmers have changed their cropping pattern. Policy related factors include decrease in public investment from 4 per cent of agricultural GDP during 1980s to 1.86 during early 2000.

Kumar and Mittal (2006) in their scholarly article on “Agricultural Productivity Trends in India: Sustainability Issues” discussed the sustainability issue of the crop productivity which is fast emerging. The post-Green Revolution phase is
characterized by high input-use and decelerating total factor productivity growth (TFPG). The agricultural productivity attained during the 1980s has not been sustained during the 1990s and has posed a challenge for the researchers to shift the production function upward by improving the technology index. It calls for an examination of issues related to the trends in the agricultural productivity, particularly with reference to individual crops grown in the major states of India. Temporal and spatial variations of TFPG for major crops of India have also been examined.

Chand et al., (2007) argues, the main factors which led to a slowdown in agriculture at national level after 1996-97 are: (a) decline in the area under cultivation, which seems to be a result of expanding urbanization and industrialization, (b) deterioration in terms of trade for agriculture, (c) stagnant crop intensity, (d) poor progress of irrigation and fertilizer, (e) decline in supply of electricity to agriculture, and (f) slowdown in diversification.

Narayanamoorthy (2007) argues that fall in wheat and rice production is not due to technology fatigue rather due to extensive mono crop cultivation and high use of fertilizers and faulty agricultural pricing. Lack of allocation of funds to irrigation development after liberalization during this period net area irrigated remained constant. This poor growth in surface irrigation has compelled farmers to rely heavily on groundwater irrigation. The increased dependence on groundwater irrigation increases the cost of cultivation and depletion of ground water resources and in addition to this the credit unavailability for investment on inputs put farmer in further crisis.

Mishra (2007) discussed that the crisis in agriculture was well underway by the 1980s and economic reforms in the 1990s have only deepened it. The major reasons brought out in the light of agricultural distress are vagaries of nature (primarily, inadequate or excessive water), lack of irrigation facilities, market related uncertainties such as increasing input costs and output price shocks mainly commercial and plantation crops due to agricultural trade liberalization, unavailability of credit from institutional sources or excessive reliance on informal sources with a greater interest burden and new technology among others.
Vanitha (2008) states that intensive cropping systems are often based on manual labour such as in traditional paddy rice and raised – bed agriculture, or on highly mechanized systems based on purchased inputs. Intensive agriculture is an essential component of habitat management because it limits requirements for new areas of land. It can, however, lead to degradation of natural resources if not managed appropriately. Modern Agriculture includes plant breeding, biotechnology and associated intellectual property rights, all of which are potentially able to adversely affect the natural resource base, particularly through declining biodiversity. High productivity is obtained in mechanized monoculture which in turn is dependent on chemicals which may inadvertently destroy desirable flora and fauna. Intensive cropping systems are suited to those environments where high yielding varieties, chemical inputs, fertile soils and irrigation can be guaranteed.

Reddy and Mishra (2008) maintain that crisis in agriculture was well underway by the 1980s and economic reforms in the 1990s have only deepened it. The major reasons brought out in the light of agricultural distress are vagaries of nature (primarily, inadequate or excessive water), lack of irrigation facilities, market related uncertainties such as increasing input costs and output price shocks mainly commercial and plantation crops due to agricultural trade liberalization, unavailability of credit from institutional sources or excessive reliance on informal sources with a greater interest burden and new technology among others.

Dwivedi, Sharma and Bhat (2011) in their scholarly article on “An Analytical Study of Capital Formation in India: With Special Reference to Indian Agriculture” say that an increase in the stock of capital in a fixed period is known as capital formation of an economy. The capital formation depends upon three factors- formation of savings, mobilization of savings and investment. Agriculture sector still dominates the Indian economic scene by providing livelihood to majority of the population. In most of the developing countries including India, agricultural development is a precondition for economic development. Capital formation is one of the basic factors for increasing
production. This is all the more important in the agricultural sector where we are faced with the task of increasing production to keep pace with the increase in population against the odd of the vagaries of monsoon. The judicious use of natural resources for sustainable production of agriculture, adoption of advanced technology and development of infrastructure for facilitating all agriculture activities, ensuring food security in the broader sense of making adequate nutritious food available and accessible to all and making agriculture a profitable activity at par with other industries in the sphere of global economy are the problems that can be successfully tackled only with a strong capital base. This requires a close monitoring of the status of capital formation which is turn things on the nature of statistical system and quality of data available for measurement of capital formation. The share of agriculture in GDP has registered a steady decline from 18.6 per cent in 2004-05 to 14.6 per cent in 2009-10 at 2004-05 prices). The declining share of agricultural sector in the GDP is a characteristic of all developing economics. The Gross Capital Formation (GCF) in agriculture sector relative to GDP in this sector has an increasing trend from 15.8 per cent in 2005-06 to 21.3 per cent in 2008-09.

Reddy and Ugandhar(2011) in their essay on “Economic Reforms and Indian Agriculture - An Analytical Note” considers that the performance of agriculture sector in the country in the recent years has turned out to be quite dissatisfactory due to sharp deceleration in the growth rate of agricultural output. There are apprehensions that high growth rate in non-agriculture sector alone would not help India to realize high growth rate in total economy if agriculture continues to remain in low growth trap. The present paper is aimed at analyzing the current status of Indian agriculture in the arena of economic reforms. This study is primarily based on the secondary data collected from the reports of the National Accounts Statistics (NAS), Central Statistical Organisation (CSO), Statistical outline of India and various issues of Economic Survey. From the catalysis it can be concluded that the total GDP, GDP of agriculture and allied, GDP of agriculture alone, GDP of fishery and GDP of non-agriculture during the post-reform period had accelerated. But this Tendency had been disturbed during 1996-97 to 2004-2005. It had also been observed that during the early years of
reforms, gap in the growth rate between agriculture and non-agriculture slightly narrowed down. But again during the latter years of reforms i.e. from 1996-97 to 2004-05 the gap between them had widened. Further, it had also been observed that the public sector capital formation in agriculture as a proportion of total capital formation in agriculture declined in the recent past as compared to the 1980s. Thus, the authors were of the view that there is a need to reverse this trend and increase public investment in agriculture so as to be able to increase the growth in this sector.

Kumar (2011) in his article on “Trends in Indian Agricultural Production in Pre and Post Reform Period” analysed the growth, special pattern and found out the determinants of food grain production in India. For this purpose, both types of data i.e., time series and cross sectionals, data were taken. The foregoing analysis clearly indicates that the performance of India in food grain production has been better than the pre reform period but not sustained. The ACGR of rice, wheat, coarse cereals, pulses, as well as the total has decreased from 2.65, 3.51, 1.37, 0.90, and 2.51 in pre reform period to 1.03, 1.14, 0.77, 0.05 and 0.96 per cent respectively in the post reform period in India.

Chowdary (2011) in his article on “Agricultural Development in Assam” estimates that in Assam rice has registered a record production in 2010-11 at 50.86 lakh tonnes which marks a 15.4 per cent growth over the previous year and which accounts for more than 5 per cent of the country’s total rice production. But, he regrets that basically an agro-based economy, Assam, the largest state of north-eastern region, has remained poor because of agricultural backwardness, in the main. The very fact that Assam has to feed 2.6 per cent of India’s population with 1.4 per cent of national income shows what development distance the state has to cover to catch up with the rest of the country. Even the other seven states of northeastern region stand on better footing since they together earn 1.3 per cent of national income to feed 1.2 per cent of the country’s population. The per capita income distance of Assam from all India per capita at current prices registered an increase from Rs.757 in 1989-99 to Rs.3599 in 1990-2000 and onward to Rs.20, 250 in 2009-10.

Kumar, Kumar and Sharma (2012) in their paper on “Rural Poverty and Agricultural Growth in India: Implications for the Twelfth Five Year Plan”
consider that the poverty alleviation has been an overarching goal of India’s development efforts since its Independence. In pursuing this objective, the planning process in the country has devised several interventions, often successful but sometimes overlapping. The Government of India, deeply concerned with widespread poverty, has implemented several anti-poverty schemes. These schemes have given thrust on creating adequate livelihood opportunities for the marginalized segments of the population, provisioning of public services and goods for improving standard and quality of life, strengthening of institutions and delivery mechanisms to empower the poor and targeted development of backward regions through resource transfers and supportive policy measures. To ensure inclusive growth, the emphasis on having a more desirable composition of Gross Domestic Product (GDP) growth by targeting an average 4 per cent per annum growth in GDP has found favour with the policy makers in the country’s Eleventh Five Year Plan.

Govindaraju, Gowda. and Naik (2012) in their essay on “Agrarian Crisis, Farmers’ Suicides in India: Trends and Issues” say that the failure of stopping farmers’ suicides speaks of the failure of previous packages declared either by the state government or the central government. They criticized that many of the government sponsored packages have not brought required rate of success. Hence, they suggest that the government should act quickly to declare income generation programmes. Instead of declaring compensation to the families who committed suicide, assistance in the form of providing employment should be started on the merit of each case. Effective water management techniques should be popularized so that effective water management of the scarce water is done effectively.

Parameswara and Roshan (2012) in the paper on “Poverty, Farmers’ Suicide and Alleviation Programmes” consider that though there is a decline in the poverty ratio in India it is painful to accept that 26 crores of people are still under the poverty line. The major contributing factor for the unsuccesfulness of poverty alleviation programmes includes absence of people’s participation, lack of good governance, and weak linkage between programmes. The paper is classified in three sections, Sec-I deals with poverty and farmers’ suicides, causes and consequences and Sec-II deals with poverty measurement and Sec-III finally
reviews all the poverty alleviation programmes. They strongly recommended that income generating activities among the farmers may reduce the rate of hike in farmers’ suicide.

Hanumanthappa (2012) in his article on “Poverty, Rural Indebtedness and Farm Distress: An Analysis” considers that despite a lapse of 64 years, indebtedness among indebted households is increasing. Indebtedness may be one of the reasons for present agriculture distress. He further says that it is not the one and all reason. Increased commercial cultivation in the place of food grain production, commercialization of valuable agricultural land, disparity among release of funds for the development of backward districts are a few reasons that should be addressed properly by the planners for the future. Rural distress arises on account of various causes but indebtedness is one of the major causes and not the one and all. There is decrease in the growth of agriculture, neglect of designing development programmes and allocation of resources, and in Karnataka commercial crops are given prime importance over big prospects, which are risky. The other reasons may be an increase in the cost of inputs, credit not meeting the needs of agriculturists, and ignoring rural allocation of resources to backward areas may be the other causes for the present distress. Against this background an honest attempt is made in understanding the present scenario of distress.

Dorge, Yadav and Kadam (2012) in their paper on “Economics of Different Farming Systems in Western Maharashtra” elaborately discussed the conditions of farming community especially small and marginal farmers in Maharashtra. In Maharashtra, there are several farming systems viz; crop based, horticultural based, dairy based and their combinations. The profitability of different crop and livestock combination is varying from region to region and even within the region also. From amongst the existing farming systems, then which one is most profitable? Therefore the present study was undertaken to examine the resource use efficiencies and productivities.

Mukherjee (2012) in his essay on “Second Green Revolution: Eastern States to Lead the Way” mentions that the first green revolution was limited to five crops with the main focus on wheat and was only limited to a few areas of the country, mainly Punjab, Haryana and Western Uttar Pradesh. The studies have revealed
that the cost intensive green revolution helped mainly the rich farmers while the small and marginal farmers did not receive the desired benefits and their conditions showed a decline. He hopes that India can definitely emerge as an agricultural power in the not-too-distant future if a better strategy is implemented. There is an urgent need to overhaul socio-economic and farm policies to remove rural disparities and remove rural poverty or at least bring it down steadily.

2.3 Studies on Measurement of Agricultural productivity:

Measurement of agricultural productivity is a very difficult task. It involves critical functional relationship between inputs and output. Though the problem is difficult, yet it receives attention of scholars of various disciplines especially of geographers, economists and agricultural scientists. Many attempts have been made to measure agricultural productivity. Most important of them are discussed below.

Thompson (1926) while measuring the relative productivity of British and Danish farming emphasized and expressed it in terms of gross output of crops and livestock’s. He considered seven parameters such as (i) The yield per acre of crops, (ii) The livestock per 100 acres, (iii) The gross production or output per 100 acres, (iv) The proportion of arable land, (v) The number of person employed, (vi) The cost of production expressed in terms of wages and labour cost, rent or interest and (vi) prices, relative profitability and general economic conditions.

Zolbel (1950) has attempted to determine the labour productivity, by cinderling productivity of labour as the ratio of total output to the total man-hours consumed in the production of that output resulting in output per man-hour. He has expressed this by means of the following equation.

\[ \pi = f (P, L) \]

where \( \pi = \text{Productivity of labour} \), \( P = \text{Productivity of labour} \), \( L = \text{Labour utilized} \).
Enyedi (1964) refers to the formula for deterring agricultural productivity. His formula is as follows.

\[
\frac{Y}{Y_n} = \frac{T}{T_n}
\]

where \( Y \) = total yield of the respective crop in the unit area.
\( Y_n \) = total yield of the crop at the national level.
\( T \) = total cropped area of the unit.
\( T_n \) = total cropped area at the national level.

Saron (1965) has applied Cobb-Douglas production function approach for the measurement of productivity. The common purpose of this function is to express input-output relationship between several inputs and one output in the agricultural system. The function takes the following form:

\[
Y = A x_1^a x_2^b x_3^c x_4^d \ldots \ldots \ldots \ldots \ldots x_n^y
\]

Where \( x_1, x_2, x_3 \ldots \ldots \ldots \ldots x_n \) denotes various inputs like land, labour, capital etc.

\( a, b, c, d \) denote elasticities of the respective factors.

Tambad (1965 and 1970) has adopted crop yield index as the basis for measuring agricultural productivity. He explains that the purpose of this analysis is to express the average yield of various crops on a farm or in a region relative to the yield of same crops on another farm or in a second region. It can be expressed in terms of the equation as follows.

\[
\text{Crop yield index} = \frac{\sum_{i=1}^{n} \frac{Y_i}{Y_{i0}} A_i}{\sum_{i=1}^{n} A_i}
\]

Where \( i = 1, 2, 3 \ldots \ldots \ldots \ldots n \) are the number of crops considered in an unit area or year.

\( Y_i \) = is the yield per acre of crop \( i \) in a farm area or year.
\( A_i \) = is the weightage of crop \( i \) denoted by the area under the crop as a percentage of total cropped area.
\( Y_{i0} \) = is the overage yield per acre of crop \( i \), at the group of farms or entire region or the base year.
Subbian and Ahamad (1980) studied Determinants of agricultural productivity in Tamil Nadu, India. This paper aims at studying agricultural productivity and its spatial variations in the light of environmental, technological and institutional factors. In order to probe into the dynamics of agricultural development in Tamil Nadu, district wise patterns of agricultural productivity are measured in monetary value per unit area at the constant price-level for the state which were taken into account for three points of time 1954-55, 1964-65 and 1970-71. The author examined a number of variables viz. soil rating index, amount of rainfall, irrigated area, fertilizer, consumption, mechanization, agricultural labourers and scheduled caste and tribal population are hypothesized to explain the areal differentiation in the agricultural productivity. In this paper explanatory model build up has been tested with a stepwise multiple regression procedure.

The study was conducted with the help of aerial photographs of 1:25,000 scale top sheet of 1:63,360 scale and by the subsequent detailed field surveyor K. Surrender Reddy and A. Kamalakar Reddy (1983). They examined crop concentration in Karimnagar district, Andhra Pradesh. This paper throws light on the changes brought over by the concentration in agricultural efficiency and related aspects connected with agriculture. The author used Bhatia's method for the calculation of crop concentration and found that the pattern of crop concentration in Karimnagar district will most probably continue in spite of the large scale development of the irrigational facilities.

There are some studies from Maharashtra also. More K.S. and Mustafa F. R. (1984) examined irrigation requirements and development in Maharashtra. In this paper authors have considered the necessity of irrigation development in the state of Maharashtra. The authors used the following requirement.

\[ \text{In} = \frac{\text{Pr} \times \text{Ac}}{\text{R}} \]

Where,

In= Irrigation need of the area.
Pr= Percentage of rural population
Ac = Percentage of cultivated area of the areal unit.
R= Rural average rainfall
The authors have made three maps regarding irrigation requirements in Maharashtra, development of irrigation and priority for the development of irrigation in the state. Varsha Vaidya and V. S. Date (1987) examined influence of some selected variables on agricultural productivity of Maharashtra. Their hypothesis was that the productivity is related to some socio-economic variables, applying correlation and multiple regression techniques. This hypothesis is tested by applying for the years taken into consideration (1961, 1966, 1972 and 1978). They have selected six variables i.e. productivity index (Bhatia 1967), Shafi’s modified productivity index, standard nutrition unit per hectare, calories per head of total population, money returns per hectare of crop land and money return agricultural worker. The authors used data for the period of 1960-61 and 1979-80.

Thakur (1989) examined agricultural productivity in south Bihar plain. The author discussed in this paper the agricultural productivity in south Bihar, as demonstrated by the coefficient of agricultural productivity. The spatial variation in productivity worked out on the basis of anchal as an areal unit is explained in terms of physical as well as human parameters that govern crop yield. The study uses mainly secondary data. The author used an anchal as a unit for studying 146 anchals which have been selected for the measurement of productivity. Here the index of land productivity is used and defined as the money value of outputs of 16 crops per unit of area occupied by the crops and given by the formula (Hussain,1976). Further the final computed values have been converted into productivity coefficient for finding the productivity with respect to the regional level. For his purpose, the following formula has been used (Enyedi, 1964):

\[
\frac{Y}{Y_n} \div \frac{T}{T_n}
\]

Where,

- \( Y \) = The total yield of the selected crops in the unit area.
- \( Y_n \) = The total yield of the crop on regional scale
- \( T \) = Total crop area of the unit.
- \( T_n \) = Total crop area on regional scale.
Jadhav (1997) examined agricultural development in Maharashtra. A spatial interpretation. The twelve parameters were selected for measuring the agricultural development by the author. He focused on the regional patterns of the levels of agricultural development to examine the interrelationships of those variables, which influence the level of agricultural development of Maharashtra. In order to get accurate and average results of the levels of agricultural development, the statistics of five years i.e. 1991-95 have been considered. The author computed the index values for each of the twelve parameters selected for analysis. Further, composite index values were calculated to develop integrated picture, for each district, by employing the following formula.

The empirical expression of measurement is = \(X_1 + X_2 + X_3 + X_4 \ldots + 12/12\)

The composite index values of the districts were classed and arranged in descending order to delineate the zones indicating the levels of agricultural development viz. High, Medium and Low.

Madhuri and Reddy (2008) examined the impact of technological development on the production of groundnut in Andhra Pradesh. The author tested the significance of the combined effect at all explanatory variables on the explained variable.

F- Test statistic has been adopted.

\[
F = \frac{R^2/(k-1)}{(1-R^2)(N-K)}
\]

Where,

\(N = \text{No. of observations}\)

\(K = \text{No. of variables}\)