CHAPTER II REVIEW OF LITERATURE

The review of literature relating to the present study on "An analysis of pattern, growth and determinants of fertilizer use in Tamil Nadu" is discussed under the following heads:

1. Importance and role of fertilizers
2. Growth pattern of fertilizer consumption
3. Factors influencing fertilizer consumption
4. Impact of fertilizer use on production and productivity
5. Other related studies.

1. IMPORTANCE AND ROLE OF FERTILIZER

There has been a tremendous improvement in Indian agriculture after independence. Fertilizer uses over the years have increased. Fertilizer use is the only alternative in the absence of scientifically budgeted cycling of residues to compensate nutrient export out of farms in crop production. In maximizing the agricultural production from an area, optimum fertilizer doses with other inputs play an important role.

Singh et al. (1976) in their study on fertilizer use and food grain production observed that agricultural production and level of crop yields depend up on a number of factor like irrigation, manures, fertilizers improved seed, pesticides, etc. of these, fertilizers and improved seed are the two most important points as they contribute significantly towards production.

Jha and Sarin (1980) made a district level analysis on fertilizer consumption in Semi-Arid Tropics (SAT) of India using the data for the period from 1969-70 to 1978-79. The study indicated that over 62 per cent of the total fertilizer (N and P2O5 and K2O) used in the SAT districts was consumed in the 78 irrigated districts which had only 35 per cent of the SAT cropped area. Thus fertilizer consumption was mainly concentrated in irrigated districts. The average level of fertilizer consumption per hectare of cropped area was 57 kg in the irrigated and 18 kg in
the non-irrigated districts. Considerable variation was noted in fertilizer consumption between districts even within irrigated and non-irrigated categories. The irrigated SAT districts showed better performance in terms of growth in the total fertilizer consumed during the study period.

An inquiry by Prakahs and Singh (1982) using the data from cost of cultivation project conducted by the Punjab Agricultural University stated that the planners should provide the right quantity of fertilizer to small farmers at right time. The availability of this variable input is capable of improving the income-generation capacity of this group of farmers and, therefore, will be helpful in bridging income disparities.

Shobti Gopal (1983) observed that, fertilizer consumption in India stood at 7.2 million tonnes of nutrients a year, recording a seven fold increase during the last 17 years. The achievement was not uniform throughout the country. The study found that the main factor besides weather which act as constraints in fertilizer use was the lack of ready, timely and adequate availability of seeds and nutrients of the right type and quality near the point of consumption, absence of timely and adequate credit both at the dealer and the farmer levels, shortage of water for irrigation and ignorance about the efficient use of fertilizers.

Subharao (1985) argued that there were differences in the determinants of fertilizer off-take in low, medium and high productivity districts in the region. In the low productivity districts, fertilizer off-take was essentially demand determined, being explained almost entirely and directly by quantity of irrigation and soil rating index. In the medium and high productivity districts, fertilizer consumption was primarily influenced by supply side factors, viz., access to fertilizer retail out-lets, credit institutions, rural road net-work and related infrastructure. The study indicated that in both low and high productivity districts, the physical and institutional environment of the district played a dominant role in conditioning the extent of fertilizer use.

Gupta et al. (1986) attempted to analyze the extent of manures and fertilizer used and their relation to the productivity on small farms. Cobb-Douglas
production function was fitted to assess the efficiency, of manures and fertilizer for two major crops, viz., bajra and wheat. The production function revealed that the efficient use of manures and fertilizer, and possibilities for the re-adjustment of the resources further increases efficiency.

Ramasamy et al. (1986) highlighted that fertilizer has been one of the important factors contributing to the improvement of crop yields in India for the past one and half decades. With the advent of the high yielding varieties in the mid-1960 the role of fertilizer has become more crucial.

Rao et al. (1986) in their study attempted to find out the risk involved in the application of fertilizers on paddy in west Godavari district. While highlighting the importance of fertilizer, they sounded a note of caution in its usage. The study observed that fertilizer was the most important yield increasing input in agricultural technology.

Singh et al. (1987) conducted a study on the pattern of fertilizer use in Punjab. The data was collected from wheat and paddy growers (1971-72, 1981-82 and 1985-86). They found that the average yields of both wheat and paddy have shown a continuous and marked increase since the early seventies. The increase was from 34.73 quintals per hectare and 36.91 quintals per hectare during 1971-72 to 39.45 quintals per hectare and 38.11 quintals per hectare during 1985-86 for wheat and paddy respectively. The co-efficient of variation in yield showed a narrowing of yield differential on different farms. The coefficient of correlation between nitrogen fertilizer applied and the yield of wheat and paddy clearly showed that the application of nitrogen fertilizer had contributed significantly to increase the yield level.

Sah and Shah (1992) evaluated the potential benefits to evolve a crop hierarchy suggesting the possible sequence of adoption and the potential benefits which have influenced the actual adoption amongst farmers. The study revealed that the farmer's behavior, considering size and certainty of incremental return was the guiding force. But the farmers' apprehension about the appropriateness of the soil test based recommendation, about incremental gains
that seemed to play a crucial role. Farmers with proper fertilizer use may perceive substantial incremental gains by increasing the use. If this is so the present proper status of fertilizer has to be seen as only incidental. The farmers are likely to change it in accordance with their own response perception. In order to get a comprehensive understanding of the farmers' adoption behavior in a dynamic context, it is necessary to evolve an alternative framework, which could take into account the forces influencing the farmer's perception.

The application of fertilizers coupled with high yielding varieties (HYV) seeds and better irrigation facilities have played a significant role in attaining self-sufficiency in food grains production in our country. The consumption of fertilizer largely depends on rainfall and can be increased by creating awareness of fertilizer-use among the farmers (Srivastava, 1994).

Nkonya et al. (1997) studied the factors affecting the adoption of improved maize seed and fertilizer in Northern Tanzania from a survey conducted on 246 farmers. The study showed that influence of fertilizer application on the improved maize seed was significant but small in magnitude whereas the effect of improved seed on the adoption of fertilizer was much greater.

Sengupta (2009) observed that chemical fertilizers in India have played a major role in raising agricultural productivity in the past four decades as a result of which we have achieved self-sufficiency in food grain production. The imports of phosphatic and potassic fertilizers have gone up substantially during last few years. In the absence of deposits of commercial significance in India, the entire requirement of potassic fertilizer is imported.

Effective implementation of government policy on fertilizer, has played and will continue to play a vital role in increasing agriculture production in the country. In addition to fertilizer, HYV seeds, irrigation, agriculture chemicals, mechanization and credit are also important. Looking at the vital role of fertilizers in agricultural production, government of India has been announcing various policies to boost fertilizer consumption in a balanced proportion, Yadev (2009).
Singh (2010) revealed that effective management of fertilizer is crucial to achieve the objectives of productivity, profitability, sustainability and environment health in crop system management. Within each of the four general principles of efficient fertilizer management right source, right rate, right time and right place, there are a number of specific practices which can be classified as fertilizer Best Management Practices (BMPs). These are site- specific, crop specific and vary from one region to another depending on the soil, climate, crop, cropping history and management expertise. Possible fertilizer BMPs for nitrogen, phosphorus and potassium have been discussed from the angle of increasing agricultural productivity on a short-term as well as cumulative crop yield response over time.

2. GROWTH PATTERN OF FERTILIZER CONSUMPTION

Agricultural development strategy framed by our planners is aimed at increasing the use of chemical fertilizers. Factors like increasing population, foreign exchange and food shortages, have accelerated food production in the country. Indian farmers have recognized the application of fertilizer to boost agricultural production.

Desai and Singh (1973) examined the data on fertilizer consumption for 286 districts in India during the period 1960-61 to 1968-69. They identified wide inter district variability in fertilizer consumption. More than 80 per cent of nitrogen (N) and phosphorus (P) was consumed in less than one third of the districts all through the period. At the other extreme, more than 50 per cent of the districts accounted for only 10 per cent of total fertilizer consumption. They further observed considerable variation in compound growth rates in consumption across the districts. In general, the districts with high growth rate of both N and P$_2$Os were with low levels of fertilizer use. However, in the central and eastern region, the districts with low level of fertilizer consumption in the base year had low growth rates.

Krishnamacharyulu and Muralidhar (1981) estimated the growth rates of per hectare fertilizer use in 18 major states of India using the data for the period from 1968-69 to 1978-79. They observed significant and positive growth rate for all the states except Kerala and Assam. Using the Spearman's rank correlation,
they examined shifts in the relative position of the states in per hectare fertilizer use with reference to base year 1968-69. They noticed that no state had shown any significant shift in its fertilizer use status. While computing the coefficient of variation for each year to determine the interstate disparities in fertilizer use, they found that there was large scale interstate variation in the levels of fertilizer use and it did not show any tendency of narrowing down over the period.

Bhatia (1983) studied the patterns of fertilizer consumption in India. The study revealed that fertilizers for different crops were applied largely in major states. There is a need for increasing the consumption of fertilizer in areas where present rates of consumption per unit of area was low but potentials are higher. During Kharif season, rice is the major crop which accounts for the bulk of fertilizer consumption and the fertilizer consumption has to be increased for increasing the productivity of rice. As marginal productivity of fertilizer is higher in areas where existing rates of consumption are relatively low, the increased use of fertilizer in those areas would increase overall fertilizer response ratio in the country and thereby help in reducing disparity in agricultural productivity in different states.

Singh (1983) using the coefficient of variation as a measure of inequalities in fertilizer use, examined the interstate variations in levels of fertilizer consumption during the period from 1961-62 to 1981-82. Although the consumption levels in all the states increased over the period, the degree of variation in levels of fertilizer use among the states had continued to remain high.

Leela (1985) studied the growth in consumption of fertilizers in the state of Andhra Pradesh and in different districts of the state. The study observed that there are considerable variations in the level of per hectare consumption of fertilizers in different districts of Andhra Pradesh over a period of two decades (1960-1980). However, there was a general increase in the levels of per hectare consumption of fertilizers in the districts. Wagmare and Dhongade (1985) carried out an economic analysis of fertilizer application and yield rates of sugarcane in Maharashtra. They concluded that sugarcane growers had not adopted the
balanced use of N, P and K fertilizers. The gap between the recommended and observed levels of nitrogen was of the order of 10 per cent to 15 per cent.

Patel (1986) in his study growth pattern of fertilizer consumption in Gujarat examined district-wise growth as well as inter-district variation in fertilizer consumption, and assessed the factors influencing the inter-district variation in fertilizer consumption. The study found that the growth in fertilizer consumption was higher in 1970's as compared to that in 1960's. The study revealed that the extent of adoption of high value crops in the irrigated area was responsible for interstate variations in fertilizer consumption in Gujarat.

Chauhan (1987) assessed the factors responsible for the glut in the consumption of fertilizer. According to the study, unfavorable weather condition, lack of breakthrough in genetic engineering and frequent increase in fertilizer prices were the factors responsible for a less than proportionate increase in the consumption of fertilizer when compared to the strides made in agricultural production.

Thakur and Shiha (1988) examined the pattern, growth and determinants of fertilizer use in different regions of Bihar. The study revealed that among the different regions, use of plant nutrients (N+P+K) was comparatively higher in the southern regions followed by northern and Chotanagapur regions. Growth rate of total plant nutrients indicated that in all the three regions, it was not only positive but marginally higher in the north region followed by Chotanagpur and southern region. The study revealed that the factors affecting fertilizer use in north as well as south were areas under high yielding varieties of irrigation and rainfall. In Chotanagpur region the area under high-yielding varieties and rainfall significantly affected fertilizer use. The study suggested an expansion of area under high-yielding varieties with assured irrigation facilities, for accelerating fertilizer use, to ensure better productivity and higher yields.

Mohanam (1989) analyzed the growth rates of fertilizer consumption in Tamil Nadu. The study found that the rate of fertilizer consumption of Tamil Nadu is less than the all-India growth rate, and the growth rates of fertilizer consumption of
the districts in Tamil Nadu almost cluster around the state level growth rate, there is inter-district variation, in the growth of fertilizer use. There is a difference in the growth rates of fertilizer consumption between the pre and post-green revolution period.

Singh et al. (1989) examined the production response of rice farmers in different locations of canal irrigation to the use of manure and fertilizers on different farm in Himachal Pradesh. It was found that the majority of farmers were using fertilizer in both the season i.e. Kharif and Rabi and it positively related to the size of the farms. It was further noticed that the use of fertilizer was below the recommended level. Waghmore and Sorgekar (1991) urged the farmers to use chemical fertilizers as part of the modern technology for agricultural production in India. The study examined the consumption pattern of fertilizers in Maharashtra in order to assess per hectare utilization and the consumption of nitrogen, phosphates, potash and all other chemicals fertilizers together. Time series data for the period from 1972-73 to 1986-87 was used. In general the trends in fertilizer use were found to be positive in all most all districts in the state. The consumption of fertilizer per hectare was found to increase from 12.84 kg in 1972-75 to 31.49 kg in 1984-87. The highest consumption level of 129.66 kg / ha was noticed in the district of Kolhapur.

Kumar et al. (1991) studied fertilizer consumption pattern in the upper Gangetic plain region. The total NPK consumption in the region during 1989-90 was 1349 thousand tones which constituted about 11.7 per cent of the total fertilizer consumption of the country.

Shiyani et al. (1991) estimated the NPK requirement for Saurashtra region of Gujarat state for the period from 1969-70 to 1988-89. The results showed significant increase in P and K, while the requirement of N remained almost static. The consumption of NPK fertilizer showed a significant increasing trend suggesting that the gap between requirement and actual consumption decreased year after year. The analysis of districts shows large variation in fertilizer consumption.

Pradhan et al. (1993) attempted to study the trend and pattern of fertilizer consumption in Orissa in 1968-1992. The study found that the growth rate of total
fertilizer consumption in Orissa was close to that of the all India level. The growth rate of per hectare fertilizer consumption of the state was 7.47 percent, as against the growth rate of 8.67 percent at the all India level. The total share in fertilizer consumption by leading five irrigated districts was reduced from 87.79 percent in 1970-71 to 73.88 percent in 1991-92.

Inamke et al. (1996) examined the fertilizer use pattern for sugarcane in respect of three recovery zones of sugarcane in Maharashtra at different points of time. They observed that among the three recovery zones, the use of N, P2O5 and K2O fertilizers was not as per the recommendation and it was very low in low recovery zone where the productivity was also very low (50 t / ha) as compared to other two zones.

Sengar and Pant (1996) in their study on fertilizer scenario in India had observed that there was a variation in both quantity and percentage use of fertilizer in southern, Eastern and Western part of the country. Fertilizers such as Ammonium Sulphate, Calcium Ammonium Nitrate, Urea, Potassium Sulphate etc., were common nutrients for better plant growth. The study indicated that the application of improved seeds, weedicides and insecticide along with fertilizers would certainly increase the food grain production and would result in real success of green revolution in the country.

Shaik Haffis et al. (1997) pointed out that fertilizer use deviated more widely in rice, groundnut, sesameum, black gram, sugarcane and cotton in different size of farms in Andhra Pradesh. Both excess- use and under-use of fertilizer nutrients were evident across different locations and crops.

Tripathi (1998) investigated the trend and pattern of consumption and production of agro-fertilizer in the country. The study revealed that India has made progress in consumption and production of fertilizer during the last 45 years. The contribution of fertilizer in food grains production was over 50 percent in the country. The consumption had increased from 66 thousand tones in 1951-52 to 13.5 million tons in 1994-95. Fertilizer production in the country in 1994-95 was more than 200 times higher as compared to 1951 figures. The fertilizer production
capacity increased remarkably during the last 45 years. Besides the remarkable increase in the production, India continued to be major importer of raw materials, intermediates and finished fertilizers.

Chandrasekaran and Krishnamurthy (1999) found that both total fertilizers use and per hectare fertilizer use had grown during 1968 to 1992. The use of P and K had grown faster than N to achieve balanced nutrition for crops. The share in total fertilizer consumption among districts in Tamil Nadu varied considerably over time as reflected by increase or decrease in per hectare consumption of fertilizer.

Mudi and Giri (1999) conducted a study on variation in the pattern of fertilizer use between Aman paddy and potato in West Bengal. Primary survey was conducted. They found that farms used different types of fertilizer in different forms and combinations either as single nutrient fertilizer or a mixed nutrient fertilizer and branded, unbranded or in the combination of both. They concluded that the potato growers had an inclination to use mixed fertilizers along with single nutrient fertilizer. Paddy growers preferred the use of single nutrient branded fertilizer. There was a positive correlation (0.39) between percentage of nitrogen placed as the top dressing and yield.

Khunt et al. (2001) observed high fluctuation in fertilizer consumption with high growth rate in Gujarat from 1961 to 2000. They also noticed increasing consumption of K in Rabi season and declining trend in Kharif season.

Saraswat and Singh (2003) studied the pattern of fertilizer consumption in Himachal Pradesh. The study revealed that the annual compound growth rate in consumption of all fertilizers was 7.06 per cent per annum. The growth of fertilizer consumption in Kharif and Rabi season was 5.88 and 8.29 per cent per annum respectively. The highest annual growth was recorded in Kullu district (9.17%) and the lowest (3.0%) in Kinnaur district.

Mehmood and Shereen (2004) examined the fertilizer demand and drought in India. They observed that of the total fertilizer, 35.1 per cent was used
for paddy, 19.3 per cent for wheat, 5.9 per cent for cotton, 5.5 per cent for sugarcane, 4.7 per cent for groundnut, 2.6 per cent for maize crop and the remaining consumption was accounted by other crops. On the whole, about 70 per cent of the fertilizers was consumed in irrigated area. Another feature of fertilizer consumption in India was that cereal crops consumed 60 to 65 per cent. Singh (2004) in his study revealed that per hectare fertilizer consumption in India was less than that in other developed as well as a few developing countries, even though the consumption has increased by six-folds in the last three decades.

A study by Xavier (2004) on yield response of crops to fertilizer use in Sivagangai district of Tamil Nadu through a survey of 200 farmers revealed that application of N was more than the recommended level in all categories of farmers while that of P fertilizers was less than the recommended level. Regarding K, marginal farmers used 44.73 kg/ha while all other farmers used more than the recommended level of 50 kg/ha.

The fertilizer market in India is growing as the demand is constantly increasing and still there is a significant gap in potential and realized demand. Fertilizer products are being introduced as specialty, water soluble or customized fertilizers. There is a well-knit dealer's network for making fertilizer available to large and well spread client of farmers throughout the country. There is need to rationalize the spread of fertilizer sale point using GIS technology. There is paradigm shift in the profile of Indian farmer i.e. more informed, educated and technology savvy. Agricultural services, such as customer relation management activities in fertilizer business, are also undergoing a change and focus is on creating a permanent bondage with customer through various group activities (Shrotriya, 2009).

3. FACTORS INFLUENCING FERTILIZER CONSUMPTION

In an agricultural economy like India, fertilizer consumption is influenced by factors such as demand, price, subsidy, import, government policies and other
such factors. As far as the farmers are concerned their level of education, age, income, and land size influence fertilizer consumption.

Agriculture production and level of crop yield depend up on a number of factors like irrigation, manures, fertilizers, improved seed, pesticides, etc. Of these, fertilizers and improved seed are most important as they contribute significantly toward production (Singh et al, 1976).

Owusu (1981) in his study on economic analysis of demand and supply of fertilizer in the United States had estimated fertilizer demand and supply function using ordinary least square method. The estimated function exhibited high degree of autocorrelation. Hence a two stage least square procedure was followed using pooled data. The results indicated that fertilizer, crop and price ratio were important in explaining the variations in fertilizer use.

Patil and Pandey (1981) using static and dynamic models, attempted to examine the influence of economic and agronomic factors in determining the applications of phosphatic fertilizers at macro level. The Cobb-Douglas type of function was used to explore the phosphatic fertilizer use in different states for the period from 1955-56 to 1975-76. The study revealed that irrigation was the most dominating factor in increasing fertilizer consumption. The real price of fertilizer did not affect fertilizer consumption in any significant manner in almost all the states. Improved farm technologies and management practices in all the states were expected to increase the future consumption of phosphatic fertilizers.

Patil and Pandey (1982) conducted a study on nitrogenous fertilizers using time series data from 1955-56 to 1974-75. The study emphasized the need for remunerative and stable price of crops apart from irrigation and technological changes. In Karnataka irrigation was the only significant factor influencing the fertilizer use over the period.

Gupta (1983) examined the trends in fertilizer consumption by using multiple Regression analysis to capture the effect of different variables on consumption of nutrient N (kg) per hectare of cropped area in India (1970-79).
Among the variables considered area under irrigation, weather, relative price of fertilizers and the share of cropped area exerted positive and significant influence on dependent variables, while the area under HYVs and the credit failed to exert significant influence.

Nagaraj (1983), using correlation and regression analysis determined the impact of factors affecting fertilizer use in different states of India. The result showed that rainfall was relatively an unimportant variable in explaining the observed variation in fertilizer use. The factors like irrigation, spread of HYV's and fertilizer intensive crops were found to have a positive and significant effect on fertilizer consumption. Relative price of fertilizers was inversely related in many cases but not significant.

Singh (1983) attempted to investigate and quantify the impact of different factors responsible for inter state variation in fertilizer consumption levels. Linear and log-linear regression models were fitted for two different time periods, 1970-71 and 1977-78. The results of the study demonstrated that irrigation, HYV crops and credit availability were the significant factors while rainfall and size of land holding failed to show any significant effect on fertilizer use.

To maintain the pace of agricultural development, heavy investment is required in the form of providing more irrigation facilities, introduction of high quality seeds, fertilizer and an optimum use of the vital inputs. Therefore Rangaand Rertegi (1983) argued that the only alternative to increase production per unit area was through the judicious use of fertilizer and organic manures besides the proper management of other inputs.

Flinn and Shakya (1985) studied the factors influencing the adoption and usage rate of fertilizer for wheat in Nepal. The study revealed that the factors related to fertilizer use in wheat were the area under cultivation, extent of irrigation, transport cost, and operators tenure status. They further revealed that fertilizer adoption was sensitive to the cost of fertilizer and procurement implying that farmers in the area were responsive to fertilizer price as reflected in procurement plus delivery cost.
Padma et al. (1985) examined the technical and economic factors influencing the adoption of modern varieties and the use of fertilizer on rice. The study found that adoption of modern varieties was highest where irrigation exists. However because half or more of Asia's rice land will remain rainfed in the foreseeable future, greater spread of modern varieties into these adverse environments would depend on new varieties being bred that are specifically adapted to these environments. Modern varieties adoption was also an important determinant of whether a farmer will use fertilizer and how much. Access to credit and in the case of fertilizers low transportation costs were significant determinants of adoption, as was frequency of extension contact. However, increasing extension visits had less impact on adoption than changes in the price related variables. Neither the farm operators' years of schooling, nor his family size was a significant determinant of modern varieties or fertilizer adoption.

Desai (1986) analyzed the policies for growth in fertilizer consumption. He opined that because of the constraints in lowering real prices of fertilizers non-price policies would be more crucial in determining the fate of future growth in India's fertilizer consumption. Under the present price environment, there was great scope to accelerate growth in fertilizer consumption through non-price policies like improving the efficiency of fertilizer use, shifting the responses functions upwards through use of quality seeds and removing the deficiencies in fertilizer supply and distribution system.

A study by Parthasarthy et al. (1986) found that a ten per cent change in irrigation results in around three per cent change in total fertilizer use when high yield varieties, cropping pattern, and season effects are kept constant. Cropping pattern effects are most pronounced. Irrigation effects are more than the H.Y.V. effects. Elasticity of fertilizer is higher for all cultivators as compared to fertilizer -using cultivators only.

Kute (1990) studied the factors influencing the use of fertilizers in plains and hilly regions of Gujarat using the time series data from 1983 to 1989. He found that weather factors such as rainfall and temperature and irrigated area had
direct relation with fertilizer use. The poor weather condition has resulted in reduction in fertilizer consumption by about 20 per cent and the drought condition has reduced the fertilizer consumption by 34 per cent.

Mohanam (1990) had attempted to study the factors determining the fertilizer use in Tamil Nadu. Three groups of factors, viz., Technological, Economic and Institutional factors were chosen for the study and their relative importance on fertilizer use had been analyzed. The study found that among 14 variables chosen, only three variables were found to be significant viz., percentage of area under irrigation, percentage of area under groundwater irrigation and credit extended for purchasing fertilizers. Among these three variables, it was found that irrigation influenced the fertilizer use to a greater extent. The quality of irrigation was consistent in influencing the fertilizer use. A simple regression analysis showed that the proportion of area and high yielding varieties was more dominantly influencing the use of fertilizers.

Uma et al. (1990) used adjustment model a version of dynamic model. This approach captured some of the dynamic elements in fertilizer demand better than simple static models without merely resorting to time trends. The results indicated that an increase in fertilizer demand to raise productivity of land would require a fall in relative price. Though the farmers stand to gain directly from the provision of subsidies, the economy as a whole suffered in the long run. Hence, they suggested that education was to be imparted to farmers about the balanced use of fertilizers and use of micronutrients wherever necessary.

John and George (1991) conducted a study on factors influencing fertilizer application for sustainable agriculture in west coast plains and the hilly regions of India. They found that relatively high cost of fertilizers, low benefit cost ratio and lack of awareness of recommended dose of fertilizer for specific crops were the reasons behind the low use of fertilizers.

Green and Ngongola (1993) using the multivariate logistic analysis examined the factors affecting fertilizer adoption in less developed countries in Malawi. The empirical findings of the study revealed that the crops grown
(maize or tobacco), farming system, variety, access to credit, off-farm employment opportunities and regular labour required were the main factors influencing fertilizer adoption.

Fertilizer use in groundnut cultivation in Orissa indicated that the importance of the use of compound fertilizer for better yield. Besides this, the yield rate could be raised to 170 kg per hectare by sowing high yielding varieties seed, using proper irrigation and compound fertilizer in pre-rabi/ summer season then kharif season. By increasing chemical fertilizer by one kg per hectare, the yield of groundnut would be increased by 2.5 kgs per hectare. Moreover, for increasing the yield level as well as production, the availability of compound fertilizer at block level and its proper distribution among groundnut growers have also much importance (Jena and Mitra, 1994).

A study by Wagle (1994) found that the demand for fertilizer in India was less sensitive to price changes. The lower price sensitivity of demand for fertilizer may be attributed to both the rapid growth in irrigated area, and also to technological breakthrough represented by the expansion of area under high yielding varieties seeds. Irrigation played a leading role in supporting the rapid growth in the use of fertilizer.

Dholakia et al. (1995) estimated price elasticity of fertilizer demand at macro level in India using both static and dynamic models with annual data for 1966-67 to 1991-92. The results indicated that fertilizer demand is price inelastic in both the short and long runs.

Sheoran and Nandal (1997) examined the factors affecting the consumption of Nitrogenous fertilizer in the state of Haryana, which is one of the target contributors to the central pool of food grain. The study found that area under nitrogen responsive crop and irrigation were the most important determinants of Nitrogen use. The study suggested a shift in cropping pattern towards nitrogen consuming fertilizers in the state. The improved farming methods and management practices, availability of Nitrogenous fertilizers on credit through government/ Cooperative outlets at subsidized rates and remunerative prices of
crop outputs so as to ensure adequate net returns to the farmers should be given due importance in any policy decision, for accelerating the use of Nitrogenous fertilizers in the state.

Rao et al. (1998) analyzed the fertilizer use pattern in different agro-climatic zones in Andhra Pradesh. The study found wider variation in fertilizer use within and across different agro-climatic zones of Andhra Pradesh, north Telangana zone and Krishna Godavari zone with higher use of fertilizer. Fertilizer use for irrigated and dry land crop was not correlated. Both demand side factor (irrigated area and area under commercial crops) and supply side factor influenced fertilizer use significantly. Area under irrigation had a negative influence on fertilizer use for dry land crops suggesting farmer's inclination to invest more in crops where the yield risk was low.

Wagle (1999) estimated fertilizer demand and private investment function in India using time series data from 1962-63 to 1988-89. They observed that exclusion of the water variable represent a serious deficiency in the specification of the fertilizer demand function. The Chow test for structural stability turned out to be significant at 5 per cent level of confidence in respect of the static model. But it is not so in the dynamic model.

A study on the fertilizer use in three crops namely, rice, sugarcane and cotton by Kayarkanni (2000) found that the relative price of fertilizers had a great influence on fertilizer use in all the three crops. It was found that fertilizer demand for the three crops was price- inelastic. It shows that the use of fertilizers is found to be higher in irrigated areas than the canal system.

Kayarkanni (2000) estimated the fertilizer demand function for Tamil Nadu. The analysis was based on the time series data from 1967-68 to 1992-93. The results of the static model indicated that relative price and land intensity were negatively related with fertilizer demand while per cent area under HYV, per cent area irrigated and weather had a positive relationship with fertilizer demand. The study indicated that 12 per cent increase in area under HYV would lead to increase in fertilizer demand by 1.13 per cent. The short-run price
elasticity for fertilizer demand was -0.3527 and adjustment co-efficient was 0.0891. The short-run fertilizer demand decreased by 3.527 per cent in response to 10 per cent increase in relative price.

Bezbaruah and Roy (2002) conducted a study to identify the factors affecting the adoption and use of fertilizer by farmers in Barak Valley. They observed that the regression coefficients for operational holding, tenancy and low land were significant and expectedly positive. The result suggested that there was no significant variation in the application of fertilizer per hectare with farm size and multiple cropping but the application of fertilizer per hectare by the farmers had been found to be significantly conditional upon availability of irrigation and access to extension service.

In general, economic factors viz., irrigation, cropping pattern, area under HYVs, prices of fertilizers, certainty and size of income, capital rationing and labour cost were important determinants of fertilizer use on the farms. Singh and Nasir (2003) pointed out that the natural factors like temperature and frequency of drought influenced fertilizer use.

Chirwa (2005) debated the smallholder farmers in Malawi who have been relatively slow to adopt the new technology, despite decades of agricultural policies that promoted the adoption of fertilizer and hybrid seed technologies as ways of improving productivity in maize farming. Alternative econometric techniques have been used in the empirical literature to analyze the factors associated with the decision by smallholder farmers to adopt new technologies. The modelling of decision was used as the latent variable and evaluated using logit regression analysis. Using bivariate probit analysis and controlling for technology acquisition through grants, it was found that fertilizer adoption was positively associated with higher levels of education, larger plot sizes and higher non-farm incomes, but negatively associated with households headed by women and distance from input markets. The adoption of hybrid seeds was positively associated with market-based land tenure systems and fertile soils, but negatively associated with age of the farmer and distance from input markets.
Waithaka et al., (2007) explored the factors influencing fertilizer and manure use at the farm level, 253 farm households in Vihiga district of western Kenya were sampled. A pair of Tobit models was used to relate amounts of manure and fertilizer used to household variables. The results of the econometric model indicated that the use of both manure and fertilizer reciprocally influence each other and are strongly influenced by household factors, and also imply that manure and fertilizer uses were endogenous. Policy changes are required to reduce the burden on farming alone in rural areas; promote the use of higher-cost, higher-value inputs such as fertilizers; improve access to input and output markets; and encourage farmer education so as to promote sustainable soil fertility management. The improved understanding of the biophysical and socioeconomic environment of smallholder systems can help target sustainable soil fertility interventions more appropriately.

Thuo et al., (2010) categorized the farm productivity in the Peanut Basin of Senegal which has been declining over time, requiring strategic interventions to reverse this trend. The research paper used econometric tools such as pooled cross-section time-series data and Probit and Tobit models to examine factors that influence the decision whether or not to use fertilizer (adoption) and the share of land on which fertilizer is used (intensity) in peanut and millet production. The results showed that the probability of using fertilizer increases where household heads have higher literacy, larger families and larger farms, but decreases where they have off-farm income. Fertilizer used was also positively associated with the amount of rainfall and varies by geographical location. The analysis indicated that both the adoption and the intensity of use of fertilizer by peanut and millet farmers have been declining over the study period 1998-2005. The findings suggested that focusing on market oriented interventions that motivate farmers to invest in improved agricultural technologies was a sensible policy option.

Okoboi and Barungi (2012) illustrated the challenges, including low productivity due to declining soil fertility, faced by Uganda's agriculture. The
study used data from the Uganda Census of Agriculture 2008/9 to provide insights into the unknown constraints of not utilizing organic and inorganic fertilizers. The bivariate probit model was used to estimate the maximum likelihood method. The estimated coefficients of the regression were reported as marginal effects. Explanatory variables with continuous values were transformed into natural logarithms to make the data normally distributed and/or their variances homogenous. In particular, the values of the following variables: years of education, distance to market, and distance all-year gravel road, were transformed into natural logarithms. The econometric results of the bivariate probit regression demonstrated that most of the farm-households use inorganic fertilizers and also apply organic fertilizers. With regard to factors influencing adoption of fertilizer, lack of knowledge on the use of and market information on fertilizer due to limited access to fertilizer-specific extension services were found to be perhaps the most limiting factor irrespective of fertilizer type. Low access to credit and constrained access to input and output markets due to distance were also key constraints to fertilizer use. Household characteristics including education level, household size, share of adults in the household, and ownership of livestock/poultry also stand-out as influencing factors on fertilizer adoption decisions. Results suggested that targeted interventions including extensive and intensive extension training and visits, and access to affordable credit and will be pertinent in the promotion fertilizer use in the country.

Teka (2012) empirically examined factors influencing fertilizer use by smallholder farmers in Bahir Dar Zuria Woreda (specifically in Robit and Gonbatkebeles). Primary cross sectional data which were collected through structured questionnaire was used. A three stage random sampling procedure was adopted to select one farmers’ agricultural cooperative, two kebeles and 100 sample respondents from the two kebeles. Descriptive statistics and econometric analysis were used in the analysis part of the paper. The descriptive statistics revealed that fertilizer application in the study area was below the recommended rate. A multiple linear regression model was used to identify variables that
determine fertilizer use among respondents. From a total of 10 explanatory variables, only 5 variables were found to be statistically significant. From these variables, numbers of livestock owned, income from chat, extension contact, saving habit of the respondent (all positively), and credit access negatively influence fertilizer use. Based on the findings, the study suggests that improving livestock sector, promoting saving habit, improving the extension project and farmers' habit of extension contact, stiff follow-up in the utilization of credit and reallocation of resources to chat production are some of the important priority areas for policy prescription in the promotion of yield enhancing technologies in agriculture.

Beshir et al., (2012) assessed the determinants of the probability of adoption and intensity of use of inorganic fertilizer in two districts of south Wollozone, in Ethiopia. The study employed cross section data to analyze the effect of farmers' demographic, socioeconomic and institutional setting, market access and physical attributes on the probability and intensity of use of inorganic fertilizer. A double hurdle model was employed using data collected from randomly selected 252 farmers between July 2009 and November 2009. Secondary data were also used to complement the primary data. The study depicted low utilization of inorganic fertilizer which was 29.6% and 19% of total cultivated crop land in Ethiopia and South Wollo, respectively. The econometric results of the study provided empirical evidence of a positive impact of extension and credit services, age, farmland size, education, livestock, off/non-farm income and gender in enhancing the adoption of inorganic fertilizer. Physical characteristics like distance from farmers' home to markets, roads, credit and input supply played a critical role in the adoption of inorganic fertilizers as proximity to information, sources of input and credit supply and markets save time and reduce transportation costs. Therefore, the results of the study suggest that the probability of adoption and intensity of use of inorganic fertilizers should be enhanced to meet the priority needs of smallholder farmers and to alleviate
the food shortage problem in the country in general and in the study area in particular.

Hussain (2012) estimated the impact of major agriculture inputs (credit disbursement, the area under cultivation, fertilizer consumption and water availability) on total rice production in Pakistan using a time series ranging from 1988 to 2010. The study used a log-linear Cobb-Douglas production function to estimate the impact and importance of these inputs. It finds of the study revealed that area under cultivation and water availability had a positive and statistically significant impact on rice production and the other two inputs had a positive but statistically insignificant impact. Estimation revealed that a 1% increase in area under rice cultivation brought a 1.64% increase in total rice production and a 1% increased in water availability increased total rice production by 0.87%. The insignificance of credit disbursement and fertilizer consumption indicates the presence of inefficiencies which begs for some policy attention.

4. IMPACT OF FERTILIZER USE ON PRODUCTION AND PRODUCTIVITY

Chemical fertilizers have played and will continue to play a crucial role in determining the level of agricultural production. The role of fertilizers in ushering the green revolution is noteworthy. It is of no doubt that the use of chemical fertilizers is the surest and quickest way to boost crop production.

Favorable impact of fertilizers on food grains production in India has been truly demonstrated, observes Sirohi et al. (1968). But when total supplies are in adequate, what is available has to be allocated between the high yielding varieties and the traditional one in such a way that the total yield from both are kept at the maximum.

Donde (1970) in his study on, market and real price of fertilizer and impact of price changes on fertilizer consumption and production of crops observed that, the output response to fertilizer use and the real price of fertilizer as distinguished from its market price determine the demand for fertilizers. The actual level of use
by cultivators indicates an equilibrium position at the prevailing price of crops and cultivators' own calculated costs of fertilizer use.

Sankhyan and Sirohi (1972) applied parametric programming model for determining the demand functions for fertilizers in Mandi district of Himachal Pradesh. The demand functions indicated a shift upwards to the right when capital constraint was relaxed through a borrowing activity. Low price elasticities suggested that the decrease or increase in the price of fertilizer would not lead to any substantial change in the demand for this input.

Sirohi and Goel (1972) attempted to determine the yield and profit maximizing doses of fertilizer with and without weather risk factor for different varieties of barley and maize crops at some centers scattered over different parts of the country. Efforts were made to estimate the relative profitability and potential increase in yield due to the use of fertilizers. The profit maximizing doses, with no risk covered were between 30 and 84 kgs per hectare and had the similar trend among different varieties and centers as followed by yield maximizing doses of phosphorus.

With regard to the optimal allocation of available quantities of fertilizer nutrients to different regions, it may be argued that under the present situation of increased prices and limited availability of fertilizers the share of western and eastern regions need to be raised from 64.05 percent to 72.80 percent and from 11.82 percent to 17.28 percent respectively in terms of nitrogenous fertilizers (Arora and Sharma, 1981 and Arora, 1981).

Singh and Pandey (1981) examined the pattern of fertilizer use on different categories of farms in different agro climatic regions of Haryana. The relationship between fertilizer use and crop yield variability, along with estimated fertilizer use efficiency by fitting production function for major crops in Haryana state were studied. The study concluded that the crop yields were highly responsive to fertilizer application in the assured and semi-irrigated regions. The increase in agricultural output in the state during the last decades may be attributed to increased application of fertilizers. With the increase in the crop yield
instability, the fertilizer use showed a declining tendency and the creation of assured irrigation facilities and infrastructures complementary to irrigation works, help in increasing and stabilizing fertilizer application and consequently boosting agricultural production.

Fertilizer consumption and the trend in the growth of food grains production have moved in the same direction. A study by Jaffarulla and Khairuowall (1984) further revealed that, in the year 1962 - 63 the fertilizer consumption was 452 thousand tones and food grain production stood at eight crore tones. In 1978-79 there was an increase in fertilizer consumption and a corresponding increase in food grains production too. As against 42.86 lakh tones of fertilizer consumption the food grains production increased to 13.1 crore tones in the year 1978-79. The anticipated food grains production of 11.6 crore tones even during 1979-80 which witnessed a drought of unprecedented magnitude, affecting 11 state implied that fertilizer has been a great catalyst for agricultural production.

Bhatnagar et al. (1986) analyzed the scope and extent of fertilizer application to mustard. The study revealed that the application of even small doses of fertilizers to mustard crops are beneficial and assure remunerative returns.

Singh and Sirohi (1988) in their study attempted to estimate the agricultural production under the normative use of nitrogenous fertilizers for each state, as well as for the country as a whole. The findings of the study revealed that there exists a large gap between the potential and the actual food grains production. The untapped production reservoir existing in different crops could be harvested through the use of optimal level of fertilizers along with other complementary inputs like irrigation water, seeds of high yielding varieties, credit and pesticides etc.

Ram and Nandal (1994) attempted a study on fertilizer use pattern in Haryana which revealed that the level of fertilizer used per hectare of cropped area in Haryana was low in less irrigated regions, Kharif season and rain-fed crops of small farms. The study revealed that efforts have to be carried out for
crops to receive an assured irrigation facility and also for efficient and balanced use of fertilizer.

Haffis et al. (1997) analyzed the actual fertilizer use patterns, extent of their deviations from recommended doses and economics of crops at different locations of Andhra Pradesh. This will in turn help the planners and policy makers as also fertilizer industry to identify factors responsible for these disparities in fertilizer use patterns and reasons, therefore to adopt corrective measures for increasing production and productivity of crops at a desired level. The study indicated that there were wide deviations in fertilizer use from recommended doses in almost all the crops and location. While N was applied excessively, P and K were under - used in most of the places even where fertilizers use was considerably high in case of irrigated crops.

Mohanty (1998) has attempted to explore the productivity and potentiality of paddy in Sambalpur district of Orissa. The study revealed that rice yield increases significantly with increasing level of Nitrogen up to 8 kg of Nitrogen per hectare (43.56 qtls / hect). The application of N:P:K as per soil test gives highest yield rate to grain (48.83 qtls / hect) response of 100% Nitrogen also gives 28.01% increase in yield over the control. But when it is associated with full dose of phosphorus the yield is increased by 30.55% over control.

A study by Shukla et al. (1998) found that rice-wheat cropping system requires large quantities of nutrients for sustained productivity. Therefore, it is generally not possible to reduce fertilizer doses in either of the crops. Production potential under NPKwas higher than that of INM over farmer's practice of fertilization. The production efficiency could be increased by evolving, short duration cultivation or by adopting balanced fertilization and standardized fertilizer recommendation. The study suggested that the farmers should be educated about sustainable integrated plant nutrients approach for maintenance of soil health and enhancing crop productivity as well as their farm income.
Vats et al. (1999) in their study on fertilizer application for sustainable yield in long term experiments observed that, balanced fertilization of nitrogen, phosphorus and potassium has shown to maintain the yield stability of crops. At a number of locations the results from long term fertilizer experiments have shown that for most of the crops taken in cereals based cropping systems the yields obtained at one and a half times the optimum rates of fertilizer application were significantly higher than those under optimum (100 percent NPK-soil test based) levels. The gaps in yield were observed to be quite large necessitating a fresh look at fertilizer recommendation to crop in view of continuous significant yield responses obtained at higher than the optimum levels to the crops even after more than two decades of continuous application of fertilizers.

Singh and Chandra (2001) in their study analyzed the effect fertilizers, irrigation and farm power in increasing food grain productivity in Uttar Pradesh. They found that the increased use of fertilizers, high yielding variety of seeds and adoption of mechanized farming will result in higher production.

Das et al. (2009) observed that the growing demand for food production to meet the hunger of ever increasing population call for increasing requirement of fertilizers day by day. In India especially in West Bengal, use of fertilizers seems to be very different for each agro-climatic zone, each district, block even village of the same block. The study was conducted in order to assess farmers’ response to fertilizer use at the micro level. As 90% of the farmers belong to small and marginal category it can be conducted that in both small and marginal farmers there is indeed a knowledge gap about the use of appropriate combination of fertilizer.

5. OTHER RELATED STUDIES

Usage of fertilizer requires much cost and risk. Farmers do not use the required level of dosage due to unfavorable weather conditions, increase in energy cost, high price of fertilizer, over - dosage of fertilizers, transportation problems, packaging etc. limit the use of fertilizers.
Perpintrup - Anderson (1982) in a study on agricultural research and technology in economic development, pointed out that fertilizer use is determined primarily by fertilizer and agricultural product prices.

Rao (1982) in his study attempted to find out the growth pattern and direction of disparities in fertilizer consumption in different states and regions of the country during the period 1970-71 and 1978-79. The study revealed that the fertilizer consumption in different states and regions during the period under study did not reveal any uniform trend. The rate of growth of fertilizer consumption in southern and western region was less than the all India level. Uttar Pradesh had the rare distinction of crossing one million tonnes, besides ranking first in consumption of nitrogenous and phosphatic fertilizers. Tamil Nadu which took a lead in nitrogenous and phosphatic fertilizer consumption was not doing well. This type of disparities increased in case of potassic fertilizer consumption. A similar finding was made by Satyanand (1983).

Sarup and Pandey (1982) identified the socio-economic characteristics discriminating fertilizer users from non-users in Orissa. The discriminant function analysis bought forth the innovative attitude of the farmer in terms of adoption of high - yielding variety seeds and plant protection measures and availability of short term credit during the crop season. The results suggested solving the institutional problems of the area to boost up the fertilizer use. Availability of improved seeds, and diffusion of technical know- how would induce the farmers to apply fertilizer.

Datta et al. (1985) conducted a study on constraints in the use of fertilizers in West Bengal by using secondary data from 1980-81 to 1996-97. The study revealed that lack of irrigation facilities and inadequate extension services as the major constraint in fertilizer consumption. They suggested that the provision of adequate irrigation facilities, expansion of extension services and imparting training to the farmers in the balanced use of fertilizers should be implemented in order to increase the use of fertilizer.
Bandyopadhyay (1986) investigated the technological constraints concerning the use of fertilizers. According to the study, the technological deficiency appears to be the major obstacle to scientific application and proper utilization of chemical fertilizer. Some crucial infrastructural and technological innovation, viz., free soil testing service to all farmers, assured irrigation, application of research findings in the farmer's fields, improved knowledge of the farmer about the various aspect of fertilizer use, water and soil management with reference to local needs would lead to higher consumption and optimum utilization of fertilizers, resulting in an impressive growth in agricultural productivity and the farm economy.

Desai (1986) in his study on fertilizer use in India had pointed out that the agronomic potential of fertilizer use in a country is determined by factors like soil quality, climatic-environment, cropping pattern, genetic characteristics of crop and use of inputs and other fertilizers.

Chhotan and Sirohi (1988) attempted to estimate the agricultural production under the normative use of nitrogenous fertilizer for each state, as well as for the country as a whole. The findings of the study revealed that there exists a large gap between the potential and the actual food grains production. The untapped production reservoir existing in different crops could be harvested through the use of optimal level of fertilizer along with other complementary inputs like irrigation, seed of high yielding varieties and credit.

Reddy (1989) studied the share of fertilizer in the total cost of cultivation of groundnut under rain fed and irrigated conditions and analyzed the efficiency of use of this scarce input. The study indicated that, on the whole, efficiency of use of fertilizers on sample farms is quite low and fertilizers need to be judiciously combined with other complementary inputs, such as credit, improved seed, improved implements, irrigation, insecticides and technical knowhow at a right time and at reasonable prices. The groundnut growers also need to be enlightened on the proper time of application and dosage of fertilizers as well as efficient methods of fertilizer application.
Wagle (1994) had estimated the functions for fertilizers and private investment in Indian agriculture. The study found that the demand for fertilizers in India was less sensitive to the price changes. The lower price sensitivity of demand for fertilizers may be attributed to both rapid growth in the irrigated area and also to a technological breakthrough represented by the expansion of the area under the high yielding varieties seeds. Irrigation played a leading role in supporting the rapid growth in the use of fertilizers. However the share of government investment declined gradually during the eighties, thus explaining the recent slowdown in the tempo of private investment in agriculture.

Sah and Shah (1995) in their study on farmers response to rice in fertilizer prices, revealed that as fertilizer consumption, the initial increase of about 30 percent in fertilizer price was almost a non-issue, given the technology and expectation of an increase in output prices. About 70 percent of the sample farmers believed that they would be able to sustain their present level of net returns and hence would not reduce the fertilizer use.

Shaik Haffis et al. (1997) analyzed the climatic zonal variation in fertilizer use and economies in different crops. The study found that there was a greater degree of inefficient use of fertilizer nutrients in the production of different crops across different Agro-climatic zone of Andhra Pradesh. Excess use of fertilizer nutrient implies increase of cost and depletion of returns. On the other hand, under use of nutrients facilities a further scope for increasing the present level of nutrients up to the economically optimum levels. Segupta (1998) examined the controversy relating to the provision of fertilizer subsidy and examined the performance of the fertilizer industry in India. Analysis of cost function and Cobb-Douglas production, function was used to study the performance of the industry, and the result revealed that the industry is subject to the law of increasing costs.

The impact of fertilizer use on productivity was much less significant in rain fed farming throughout the country. The average use of fertilizer remained quite low (25 kg / ha) in rain fed crops. A number of constraints limiting the wide spread use of fertilizer in dry lands was noticed. Uncertainty of rainfall was one of
the primary risk factors influencing the farmer's decision in using this expensive input (Singh et al. 1999).

Velrasu et al. (1999) pointed out that there was a wide disparity in fertilizer use among various categories of farmers and crops. Fertilizer use was high on irrigated areas compared to dry land areas. N fertilizers was exclusively used and P and K fertilizer were under used, only N fertilizer was found to have an explicit impact on crop productivity in majority of the crops.

Singh et al. (1999) examined the trend and disparities in fertilizer consumption in western Maharashtra. The study observed that there was a variation in the level of per hectare consumption of fertilizer in different district of western Maharashtra during the period 1968-92. However, there was a general increase in the level of per hectare consumption of fertilizer in the district. The study suggested the causes for inter-district variations in the level of per hectare consumption of fertilizers. The study recommended to reduce the inter-district variation by giving due consideration to the agro-climatic and resource endowment position of different district in the state.

Singh et al. (2000) studied constraints in fertilizer use in Arid Zone of Western Rajasthan. They found that among the fertilizer users, maximum farmers have applied more nitrogenous fertilizer as compared to phosphatic fertilizer and fertilizer applied was less than the recommended dose. The main constraints perceived by the farmers were lack of irrigation facilities, high cost of fertilizer and lack of knowledge on fertilizer use.

Vatta and Dhawan (2000) in their study highlighted the trends and changes in the fertilizer consumption and the factors affecting fertilizer use in Punjab. The study found that the fertilizer use has increased both in terms of total as well as per hectare in the state. However, increase in fertilizer use per hectare of cropped area was almost stagnated during the nineties. It necessitates a greater attention towards research and development of high-yielding varieties and new crops. The study further revealed that the consumption of fertilizer in the
state was highly imbalanced. Proper and extensive efforts, effective pricing of fertilizers would help in achieving the objective of balanced fertilizer use.

A study by Mondira Mukherjee (2002) observed that imbalance in levels of fertilizers due does exist, but it is not because of over consumption, rather it is because of fertilizers from their recommended levels. P and K fertilizer are largely under-utilized because they are costly and are also less recommended than N. N on the other hand is over utilized in some states as it is cheap rate because of its higher recommendation in agriculture than P and K. K imbalances have declined very slightly in India, but for N, P and total fertilizers the imbalances in India have increased.

Ramesh and Anand (2007) in their study analyzed the fertilizer purchase and usage behavior of farmers in Karnataka. The study found out that farmers are rational both in usage and purchase of fertilizers and the quantity of fertilizers applied per acre was dependent on the type of crop grown. The NPK ratio applied was very imbalanced as compared to the recommended dose of fertilizers in all the crops. Some of the most important problems faced by the farmers were lack of credit, higher prices of the fertilizers and non-timely availability of fertilizers.

Seethalakshmi (2007) analyzed the use of fertilizer by paddy growing farmers. The study revealed that the consumption of chemical fertilizers is giving way to bio-fertilizer and micro nutrients at par with drip irrigation replacing the multipurpose projects like Bhakra and Nangal. This combination of change in fertilizer and irrigation has obtained a new concept called "fertigation" and which in future is going to change the name of agriculture itself to hyper culture which has been pioneered in the west like the industrial revolution which had its origin in Europe. India has taken only the first step and has to go a long way when the former President of India Abdul Kalam's dream would become a reality.

The fertilizer industry having a long association with farmers can play a significant role in the changing scenario of fertilizer policy initiatives, i.e., nutrient based subsidy regime, payment of subsidy directly to the farmers, to strengthen their core business, step into allied business and explore possibility of entering
into new business. The paper by Singh and Das (2009) deals with the present rural retail scenario in the country and explores the productivity for the fertilizer industry to usher in a new era of retailing, which will help to cope with expected change due to the changing fertilizer policy initiatives. Efforts have been also made to suggest a way ahead to identity the challenge faced by the rural retailers and ways and means to address these challenges.

Fertilizer use in India has seen higher growth rate than any other major agricultural input in the last four decades. There has recently been a serious slowdown in the growth of fertilizer use, primarily caused by supply-side constraints. The composition of fertilizer use has also resulted in serious imbalance in the use of major plant nutrients, which could cumulatively have a detrimental effect on soil health and crop productivity. The main cause of the imbalance is found in the price distortions resulting from the structure of fertilizer subsidies. The trend in the price of agriculture product offer scope for reducing and rationing fertilizer subsidies to boost fertilizer production and reduce nutritional imbalances (Chand and Pandey, 2009).

Roy (2010) argued that the fertilizer policies announced by government of India prior to decontrol of phosphatic and potassic fertilizers in the year 1992 were conducive and paid rich dividend in terms of increased investment in the fertilizer industry and thereby created new capacities and enhanced fertilizer production and use resulting in increased food grain production.

RESEARCH GAP

state and districts level and in farm economy are extremely limited. Keeping this point in view an attempt has been made to study the determinants of fertilizer consumption in Tamil Nadu.