

II. REVIEW OF LITERATURE

The literature pertaining to the study on “**A comparison of economic performance between organic and inorganic farming in selected districts of Tamil Nadu**” is discussed in this chapter under the following captions:

- A. Resource use efficiency in organic / inorganic farming system
- B. Measurement of efficiency in organic / inorganic farming system
- C. Costs and returns of organic / inorganic farming system
- D. Constraints and opportunities in farming System
- E. Conversion from inorganic to organic farming system
- F. Other related studies

A. Resource use efficiency in organic / inorganic farming system

Patil and Acharya (1974) used the cost concepts generally used in farm management studies in India to estimate and compare the cost of cultivation between sugarcane and banana in two districts of Maharashtra. A modified Cobb-Douglas type of production function was employed for estimating the resource productivities of land, human labour, seeds, manures and fertilizers. The analysis revealed that in no case did the coefficients exceed the unity there by indicating diminishing returns to individual factors in both the crops.

Verma and Pareek (1975) studied resource-use efficiency in Jaipur district and found higher marginal productivity of land on small farms as compared to that on large farms. They stated that in order to get more income from the limited area of land available, the small farmers cultivated their land more intensively.

Kademani (1983) conducted research on economics of intercropping, in Bijapur and Dharwad districts of Karnataka. To measure the resource use efficiency of various inter-cropping systems, Cobb-Douglas type production function was used by considering the input variables in their value terms. The regression coefficients worked out for different inputs used in different crop combinations indicated that land was used more efficiently compared to other inputs. Traces of over utilization were observed in the case of seeds, fertilizers, human labour as well as bullock labour in a number of crop combinations.

Radha et. al (1989) evaluated the resource-use efficiency in rice-rice and rice-pulse farming systems of Krishna district in Andhra Pradesh. The results indicated that manures and fertilizers and irrigation were quite productively used in both the farming systems. The sum of the elasticities indicated the operation of constant returns to scale in both farming systems.

Shareef (1992) studied the input-use efficiency of rice crop in three regions of canal irrigation system in Andhra Pradesh. The study revealed that the coefficient of determination (R^2) was 0.86, 0.68 and 0.79, respectively for head, middle and tail regions. The coefficient of fertilizer (0.9885 and 0.6784) was found significant in head and middle regions. The coefficient of labour was 0.347 and found significant in the middle region. The marginal value product (MVP) of fertilizer was ₹ 116 and ₹ 86 for head and middle regions, respectively and was found significant in both the regions. The MVP of labour was ₹ 18 in the middle region and found significant. Thus, it was concluded that there existed potentials for maximizing the level of crop output through resource allocation.

Subramanian et. al. (1992) analysed the input-use efficiency in the command area of lower Bhavani project in Tamil Nadu. The multiple regression analysis carried out in these regions indicated positive and significant influence of fertilizer on the productivity of rice in all the three regions. The marginal value product of fertilizer was ₹ 20, ₹ 19.80 and ₹ 38, respectively in the three regions indicating that there was scope for increasing the level of fertilizer use to increase the productivity of rice.

Koppad (1993) studied the efficiency in the use and allocation of resources in Malaprabha command area in Karnataka. The study revealed that in the case of hybrid cotton, the ratio of marginal value product (MVP) to marginal factor cost (MFC) for land was greater than one in head reach only (1.41). It implied that income could be raised by using more land while it was used uneconomically in the mid and tail reaches. The ratio of MVP and MFC of human labour in head and tail reach indicated the scope for increasing the use of human labour and in the mid reach it was optimum. Regarding maize, the elasticity of coefficient of land in tail reach was highly significant (0.8587), which indicated that land was the major factor influencing gross income.

Nagaraj (1995) studied the resource-use efficiency of various crops included in each cropping system in Tungabhadra command area in Karnataka. The study indicated that land, manures and fertilizers together had maximum influence on gross returns of maize in maize-sunflower system. In case of sunflower after maize, land was the single most factor which was greatly influencing the gross

returns. The ratio of MVP to MFC for machine labour and bullock labour was less than unity, indicating the over use of these resources in maize production. In case of cotton in head reach, seed had the maximum influence on farm income followed by plant protection chemicals. The independent variables included in the analysis explained the 96.18 per cent of the variation in gross income for cotton.

Aswathareddy et. al. (1997) studied resource-use efficiency in groundnut production under rainfed conditions in Challakere taluk of Karnataka. The study revealed that land and farm yard manure in the case of small farmers and farm yard manure in the case of large farmers contributed significantly to production. The average mean technical efficiency indices of small and large farm groups were 0.679 and 0.646, respectively showing that small farmer groups were achieving yield levels, which were more efficient than the large farmer groups.

Nagaraj et. al. (1998) studied resource-use efficiency in various crops under different cropping systems in Tungabhadra command area. In majority of the cases, the cost incurred on manures and fertilizers was more than warranted. According to the findings of the study crop-wise profits could be increased through reallocation of available resources even without significant shift in the level of resources. The study suggested the need to intensify agricultural extension activities in the command area to educate farmers on resource management practices for realizing higher net returns.

Essa et. al (2008) used data from 700 households in the central highland districts of Ethiopia to assess farm-level resource use efficiency and to determine factors that influence inefficiencies in the production of wheat and chickpea, the major important crops in the country. The study established that small holder farmers were resource use inefficient. Moreover, a two-limit Tobit regression model results revealed that inefficiency in resource use is positively and significantly affected by family size, farming experience and membership to associations. It was also found that those households whose decision makers have roles in their community activities showed improved resource use efficiency. Moreover, the findings show that eliminating resource use inefficiency could contribute about 31.28 per cent of the minimum annual income required for the sustenance of an average farm household. The study established that resource use efficiency and productivity gains were likely to be significantly improved through expansion of non-farm sectors, reform of farmer related associations and

integrating community leadership in various community activities and programs. Moreover, market infrastructure development would likely increase efficiency and agricultural productivity.

Roy et. al (2009) attempted to measure and compare resource use efficiency and relative productivity of farming under different tenure conditions in an area of Bhola district. Sample farmers were classified as owner, crop share tenant and cash tenant farmers. A total of 90 samples, 30 from each class were selected on the basis of random sampling technique. The study explored the difference in the efficiency and productivity among owner, cash tenant and crop share tenant. Total cash expenses as well as total gross costs for producing HYV Boro rice was highest in owner farms and lowest in crop share tenant's farm. When individual inputs were concerned it was observed that expenses on human labour shared a major portion of expenses in the production of HYV Boro rice where owner operators used more hired labour compared to other groups. However, the cash tenant farmers were more efficient than owner and crop share tenant farmers. Due to poor resource base the crop share tenants were unable to invest on modern farm inputs.

Onoja et. al (2010) determined the technical efficiencies of farm credit along with other farm resource inputs in farms within the country's second largest producer of cassava, Kogi State, Nigeria. A stratified random sampling was used to select 174 cassava farmers from two agricultural zones of the state. Results of their responses to the structured questionnaire items administered were analyzed using a Cobb-Douglas production function to fit the determinants. Farm credit, farm size, chemical fertilizer quantity applied, labour and seedlings planted were significant determinants at 0.05 per cent and 0.01 per cent levels. An increasing returns to scale (4.855) was confirmed among the farms while the overall technical efficiencies were high (81per cent). Need for policy interventions in farm credit access, panel data survey to ascertain sources of variation in the various zones, promotion of use of organic fertilizer while adopting improved varieties and enhanced extension contacts were recommended.

Gawaria et. al (2010) made an attempt to document the economic efficiency of wheat production in arid region of Rajasthan. Eighty farmers were selected randomly among the farmers using new technology (W-377 variety of wheat) as well as traditional technology. The results indicated that modern technology generated higher technical efficiency. The higher technical efficiency could be achieved due to efficient use of inputs. If the farmers used inputs efficiently, 22 per cent more yield could be obtained. Similarly, there is ample scope to increase the wheat production by nearly 32 per

cent. This would be possible by efficient use of resources and increasing more inputs up to the level of optimum. The low economic efficiency can be reduced by educating the farmers using traditional technology and promoting to divert more resources by providing more attractive price mechanism.

Nethrayini et. al (2011) examined on the resource use efficiency and the participation of women in production of gherkin crop under the system of contract farming in Tumkur district of Karnataka. The results revealed that the variables included in the function satisfactorily explained 93 per cent variation in the dependent variable. The output elasticities of human labour was positive and significant at one percent. The other inputs like bullock labour, tractor labour, plant protecting chemicals and staking materials was positive which indicated that they had a positive impact on gherkin production. The variables such as FYM and fertilisers and seed had negative co-efficient indicating that these resources when added more would decrease the gross returns. The sum of elasticities showed that production is in the decreasing returns to scale. Women played an important role by participation in decision making like taking up of crop, decision regarding farm operations etc.

Chapke (2011) examined the resource-use efficiency in sorghum production in coastal region of Andhra Pradesh. Data for the study were collected from 100 sorghum producers in seven villages in the study area pertaining to the 2008-09 crop season. Farm budgeting technique and production function analyses which incorporate the conventional neo-classical test of economic and technical efficiencies were used as the analytical techniques. Findings revealed that the farmers were inefficient in using the resources. The seeds and irrigations were found to be over-utilized, while fertilizers, labourer and agro-chemicals were found to be under-utilized. The results showed that appropriate adjustment is required for optimum allocation of resources and to maximize the revenue from the sorghum cultivation.

Banaeian et. al (2011) estimated the production function, to obtain relationship between agricultural inputs and walnut yield in view of energy inputs and to make an economical analysis in walnut (*Juglans regia*) orchards in Hamedan, Iran. For this purpose, Cobb-Douglas production function was applied. Random sampling technique was used for data collection. The results revealed that human labour, farmyard manure, chemical fertilizers, water for irrigation and transformation contributed significantly to the yield. The results of sensitivity analysis of the energy inputs showed that the Marginal Physical Productivity (MPP) value of human labour was the highest, followed by farmyard manure and water for irrigation energy inputs respectively.

Amodu (2011) used stochastic frontier production model to analyze the resource use efficiency of part-time food crop farmers in Idah, North Central Nigeria. The result showed that farm size, labour and planting materials were significant determinants of farm output in part-time food crop farming. Analysis of inefficiency factors reveal the significant inefficiency variables to include; level of education, household size and farming experience. The result also showed that over 72 per cent of part-time farmers were above average in resource use efficiency; maximum efficiency was 0.98, while minimum efficiency was 0.36 with mean efficiency of 0.65. The study also revealed that rising age and household size contributed to resource use inefficiency in part-time food crop farming, while level of education and years of farming experience increased resource use efficiency among the sample farmers. Implications were that policies that would encourage relatively younger and educated persons and provide them easy access to improved seeds and fertilizers will go a long way in enhancing resource use efficiency in part-time food crop farming.

Taru et. al (2011) examined the economic efficiency of resource use in groundnut production in Michika local government area of Adamawa State. It focused on the relationship between groundnut output and the various inputs used by groundnut farmers, elasticity and economic efficiency of resource used in production of groundnut. Primary data were basically used with the aid of structured questionnaires administered on 143 farmers using a simple random technique. The regression analysis indicated that the Cobb- Douglas function gave the best fit. The R^2 was highly significant at 1 per cent level with the value of 0.784 per cent. This implied that 78.84 per cent of the total variations in groundnut yield were explained by combining influence of all the explanatory variables (farm inputs) in the regression equation. Three out of the eight independent variables were significant at 1 per cent level, these were farm size, seed and labour input more so they positively affected the groundnut indicating that the more the farm size, quantity of seed and labour used, the more output. Economic efficiency of resource use showed the seed and labour were underutilized, while fertilizer and agro-chemicals were over utilized.

Goswami (2012) examined the cost of cultivation, human labour utilisation, profitability and resource use efficiency of rice farming under tank irrigated, canal irrigated and dry land situation in Gondia district, Maharashtra. Data were collected from 150 rice farmers, 75 having land holding more than 2 hectares (big) and 75 having land less than 2 hectares (small), from three villages having 25 small and 25 big from each farming situation in each village. The data were collected for agricultural

year 2008-09 by following probability proportional random sampling technique through interview method. Cost of cultivation, operation wise utilisation of human labour and profitability were analysed through conventional estimation procedure. Resource use efficiency was analysed by using Cobb-Douglas production function. Findings revealed that per hectare total cost of rice cultivation was higher in small farms in all the three situations. Labour requirement per hectare was also higher in small farms of the three situations. The highest B:C ratio was estimated for large farms of canal irrigated situations. Resource use efficiency analysis indicated that the farmers were inefficient in utilisation of all the resources. Small farmers were observed to be more efficient than the big farmers in using available farm resources. The results showed that there is need for making inputs such as fertiliser, seeds, credit etc. affordable and accessible to the farmers so as to improve efficiency. There is also need for formulating policies for creation of alternative employment opportunities to absorb the excess labour used in rice production in the study region.

Marie (2013) aimed to assess the efficiency of usage of production factor labour by organic farms in the Czech Republic. Cobb-Douglas production function was estimated using maximum likelihood approach. The results showed high inefficiency in labour usage among organic farms – almost from 67 per cent. The efficiency was very low – only 56 per cent. The less inefficient were large farms (33 per cent in average), while micro farms (70 per cent) and small farms (81 per cent) were the most inefficient. On the other hand, large farms were the most efficient (from 73 per cent). There were also statistically significant differences among unequally sized farms. This was in line with the theory of returns to scale suggesting that larger farms were more efficient in input usage as they can benefit from their size.

Saikumar et. al (2013) conducted a study in three districts namely Bidar, Bellary and Raichur of north-eastern Karnataka with an objective of studying the resource use efficiency and to identify the constraints faced by farmers in farming activities. Multi-stage proportionate random sampling was adopted in selecting the respondents. Majority of the farmers in the study area were practising only animal husbandry as subsidiary enterprise, field crops were the major enterprises. Results revealed that the inputs like feeds + concentrates were over-utilised and number of cows and seeds were underutilised in Bidar district. The resources like land, number of cows, fertiliser + Farm Yard Manure (FYM) were over utilised and labour , plant protection charges + veterinary charges were under-utilised in Bellary districts In Raichur, fertiliser + Farm Yard Manure (FYM) and labour were

underutilised. Results indicated the scope for reorganisation of resources to optimise their use to enhance returns. In all the districts, the use of resources that were showing negative production elasticity should be decreased to achieve the optimality in the resource use and the use of resources showing more than one elasticity should be encouraged to enhance the profitability condition. There were several problems associated which were grouped under two heads namely production constraints and marketing constraints. For safeguarding the farmers' interest to enhance farm efficiency, arrangements should be made to avail timely and adequate credit and storage, inputs and market information.

B. Measurement of efficiency under organic / inorganic farming system

Kutaula (1993) applied a frontier technology to wheat crop grown on reclaimed soils of Karnal district in Haryana. The study revealed that there existed a big scope to increase technical efficiency of the wheat farms with the given level of inputs. The mean technical efficiency was found to be 0.76. This implied that the actual output of wheat on an average was 24.0 per cent less than the frontier output.

Banik (1994) studied the technical efficiency of irrigated farms in Choto Asulia village of Bangladesh. The results showed that 88 out of 99 farms had a technical efficiency of 71 per cent or above. Thirteen farms showed technical efficiency of 91 to 100 per cent and ten out of these farms belonged to the category of small farms. The average technical efficiency for the entire sample of farms was 78 per cent, indicating that there was considerable scope for increasing the technical efficiency of sample farms as a group.

Mbowa (1996) used DEA to examine resource use farm efficiency on small and large-scale farms in sugarcane production in Kwazulu-Natal. The study results showed that small-scale farmers were technically inefficient than large-scale producers and concluded that the size of farm operation affects the level of efficiency attainable.

A study by Battese et. al (1998) on paddy rice farms in Aurepalle India, which used panel data for 10 years, and concluded that older farmers were less efficient than the younger ones. Farmers with more years of schooling were also found to be more efficient but declined over the time period.

A study by Wilson, et. al (1998) on technical efficiency in the UK potato production used a stochastic frontier production function to explain technical efficiency through managerial and farm characteristics. The mean technical efficiency across regions ranged from 33 to 97 percent. There

was high correlation between irrigation of the potato crop and technical efficiency. The number of years of experience in potato production and small-scale farming were positively correlated with technical efficiency.

Shenggen Fan (1999) developed a frontier shadow cost function approach to estimate empirically the effects of technological change, technical and allocative efficiency improvement in Chinese agriculture during the reform period (1980-93). The results revealed that the first phase rural reforms (1979-84) which focused on the decentralization of the production system had significant impact on technical efficiency but not allocative efficiency. During the second phase reforms which was supposed to focus on the liberalization of rural markets, technical efficiency improved very little and allocative efficiency had increased only slightly. In contrast, the rate of technological change continued to increase, although at a declining rate during the second phase reform.

A study by Liu, et. al (2000) on technical efficiency in post-collective Chinese agriculture concluded that 76 and 48 percent of technical inefficiency in Sichuan and Jiangsu, respectively, could be explained by inefficiency variables. The authors used a joint estimation of the stochastic frontier model to determine this.

A study by Mwakalobo, (2000) revealed that conventional farmers display inefficient use of available resources in coffee production in Rungwe, Tanzania. The results indicated that farmers would increase farm efficiency by the use of adequate capital-intensive input levels in order to maximize their efficiency. However, in order to achieve the use of capital intensive inputs, farmers were encouraged to form groups/associations through which these farmers can take the advantages of increasing the bargaining power in both input and output markets. Farmers' groups/associations could provide group liability in the procurement of credit from both formal and informal financial lending institutions. This in turn would improve farmers input purchasing power.

Awudu and Huffman (2000) studied economic efficiency of rice farmers in Northern Ghana. Using a normalized stochastic profit function frontier, they concluded that the average measure of inefficiency was 27 percent, which suggested that about 27 percent of potential maximum profits were lost due to inefficiency. This corresponds to a mean loss of 38,555 cedis per hectare. The discrepancy between the observed profit and the 23 frontier profit was a result of both technical and allocative efficiency. Higher levels of education reduced profit inefficiency while engagement in off-

farm income earning activities and lack of access to credit experience higher profit inefficiency. The study also found significant differences in inefficiencies across regions.

Awudu and Richard (2001) used a translog stochastic frontier model to examine technical efficiency in maize and beans in Nicaragua. The average efficiency levels were 69.8 and 74.2 percent for maize and beans, respectively. In addition, the level of schooling represented human capital, access to formal credit and farming experience (represented by age) contributed positively to production efficiency, while farmers' participation in off-farm employment tended to reduce production efficiency. Large families appeared to be more efficient than small families. Although a larger family size puts extra pressure on farm income for food and clothing, it does ensure availability of enough family labour for farming operations to be performed on time. Positive correlation between inefficiency and participation in non-farm employment suggested that farmers reallocate time away from farm-related activities, such as adoption of new technologies and gathering of technical information that was essential for enhancing production efficiency. The result indicated that efficiency increased with age until a maximum efficiency was reached when the household head was 38 years old. The age variable probably picks up the effect of physical strength as well as farming experience for the household head.

In a study by Wilson, et. al (2001) a translog stochastic frontier and joint estimate technical efficiency approach were used to assess efficiency. The estimated technical efficiency among wheat producers in Eastern England ranged between 62 and 98 percent which means that farmers who sought information, had more years of managerial experiences, and had large farm which were associated with higher levels of technical efficiency.

A study by Mochebelele and Winter-Nelson (2002) on smallholder farmers in Lesotho used a stochastic production frontier to compare technical inefficiencies between farmers who sent migrant labourers to the South African mines and those who did not. They concluded that farmers who send migrant labourers to South African were closer to their production frontier than those who do not.

Oude Lansink et. al (2002) compared efficiency measures of organic and conventional farms in Finland. They suggested that organic producers had higher technical and sub-vector efficiencies than conventional farms in their own reference groups, but overall efficiency measures suggested that organic farms were using less productive technology.

Gautam and Jeffrey (2003) used a stochastic cost function to measure efficiency among smallholder tobacco cultivators in Malawi. Their study revealed that larger tobacco farms were less cost inefficient. The paper uncovered evidence that access to credit retards the gain in cost efficiency from an increase in tobacco acreage. This suggested that the method of credit disbursement would have been faulty.

Belen et. al (2003) estimated technical efficiency in the horticultural production sector in Navarra (Spain). Tomato and asparagus production were analysed separately. Both a non-parametric and a parametric approach to a frontier production function were used and the differences in the results were discussed. In a second stage the degree to which the calculated efficiency correlates with a set of explanatory variables representing different features of farms such as size, factorial returns and economic performance were examined. The results indicated that both tomato and asparagus production were relatively inefficient, with potential in both cases for reducing input and increasing output. The estimated measures of technical efficiency were positively related with the partial productivity indices and negatively related with the cultivation costs per hectare. No conclusive results were obtained for the relation between size and efficiency.

Cislino et. al (2003) compared organic and conventional farming in order to identify some of the main differences between those groups of farms that participated in the official Farm Accountancy Data Network (FADN) - 2003. Findings showed that organic farmers can (partially) overcome the productivity gap (with respect to conventional ones) by more efficient use of their inputs (with respect to their own frontier).

Luanne Lohr et. al (2004) estimated a stochastic distance function frontier using data from a national survey of organic farmers in Hawaii to evaluate the effect of farm-specific attributes on efficiency. Farm-specific and regional variables that shift efficiency were incorporated into the multi output distance function, including organic farming experience, use of soil-improving inputs, and farmer involvement in research. Participation in research projects reduces the level of on-farm technical inefficiency with mean technical efficiency of participating farmers 25 per cent higher than non-participating farmers. The results suggested that differences in productivity across organic farmers were closely linked to input use and observable management decisions.

Revilla et. al (2005) gathered survey data from a random sample of 200 farmer adopters and 59 non-adopters of rice interplanting in Yunnan Province, China in 2000. The data were used to

analyze the effect of interplanting on technical efficiency of rice production and to identify the sources of inefficiency, using a stochastic frontier production function. Results showed that adoption of rice interplanting was the major contributing factor to increased technical efficiency in rice production. Separate analyses for adopters and nonadopters clearly showed that although rice interplanting was mainly aimed at controlling blast disease, the absence of the disease also increased the productivity of other inputs like labour, seeds and fertilizer. Farming experience and access to extension were both significant variables for improving technical efficiency. As a farmer's experience increases, so do their skills in optimally allocating the resources at his/her disposal. The more experience a farmer has, the higher his output and the higher the technical efficiency. Similarly, farmers who had access to extension agents readily adopted the interplanting technology and as a result performed better.

In Italy, Madau (2005) applied a stochastic frontier production model and found that conventional cereal farms were significantly more efficient than organic cereal farms, with respect to their specific technology (0.892 vs. 0.825). Results showed that 63.7 per cent of the differentials between observed and best practice output was explained by technical inefficiency for the conventional group, while this value was close to unity for organic farms.

In another recent study, Larsen and Foster (2005) compared efficiency measures of organic and conventional farms in Sweden by a non-parametric technique. Their results indicated that the average efficiency scores of the organic producers were lower than the average efficiency of the conventional producers (0.44 and 0.49 respectively).

Betty (2005) estimated the level of technical efficiency in maize production in Kenya using the Stochastic Frontier Approach. This study utilized the primary cross-sectional rural household data for the main harvest-cropping season provided by Tegemeo Institute of Agricultural Policy and Development in Kenya. Results indicated that the mean technical efficiency of Kenya's maize production was 49 per cent; however, this ranges from 8 to 98 per cent. There was distinct intra and inter-regional variability in technical efficiency in the maize producing regions. In addition, technical efficiency varied by cropping system; the mono-cropped maize fields have a higher technical efficiency than the intercropped maize fields. The number of years of school the farmer had in formal education, age of the household head, health of the household head, gender of the household, use or no use of tractors and off-farm income had impact on technical efficiency. The estimated marginal effect showed that, *ceteris paribus*, the use of purchase hybrid maize seed increased technical

efficiency by 36 per cent (6.14 bags). Households who have used tractors for land preparation increased technical efficiency by 26 per cent (4.41 bags). An additional year of school had an increase in technical efficiency by 0.84 per cent (0.14 bags). However, technical efficiency increases at a decreasing rate with an increase in the number of years of school. The model also suggested that a maize producer needs only an elementary education (5 years of school) to be technically efficient.

Hasan (2006) analyzed the efficiency structure of Turkish agriculture in farm household level by using various models of stochastic frontier analysis. A household level survey conducted in 2002 and 2004 was used in the analysis. Firstly, an efficient production frontier was estimated by a panel data models. By using these estimates, relative importance of production factors and their interaction with various farm specific factors were inspected. The parameters of production frontier showed that agricultural production was crucially dependent on land and there was an excessive employment of labour in Turkish agriculture. Secondly, the efficiency scores were estimated at farm household level. The results were reported according to NUTS-II regional classification and many other farm specific characteristics. The western parts of the country were found to be relatively more efficient and there was a high deviation in mean efficiencies of different regions. There was an increase in mean efficiencies of all regions from 2002 to 2004. Besides, crop patterns, farm size, education level of household chief and irrigation were found to be effective on efficiency.

Shanmugam et. al (2006) attempted to estimate the technical efficiency – a measure of how well inputs were being used towards producing output – of about 250 Indian districts in 1990-91. It employed the stochastic frontier function model. The results indicated that (i) the land elasticity was the highest followed by fertilizer; (ii) the mean efficiency of raising agricultural output was 79 per cent and therefore there was a scope for increasing output by 21 per cent without additional resources; (iii) states such as Madhya Pradesh, Uttar Pradesh, and Rajasthan had the largest number of districts with below average technical efficiency and they gain the most from policy interventions towards improving technical efficiency. The results further indicated that health, education, and infrastructure were powerful drivers of efficiency at the district level and the relative importance of the determinants of efficiency across districts depended greatly on environmental factors, such as agro-climatic zones, technological factors, and crop mix. The results highlighted the need for developing policy strategies at a more localized level.

Atheendar et. al (2006) made an attempt to quantify the effect of improved population health on technical efficiency in agricultural production. Using data for over 260 districts in 15 Indian states, they employ the random-coefficients technique to estimate a Cobb-Douglas production function, computing overall and input specific technical efficiencies for each district. They found that decreases in the infant mortality rate, as well as increases in the literacy rate and level of irrigation, were associated with significant increases in overall technical efficiency, and that a good portion of health's effect is probably due to improvements in the efficiency of labour use. While efficiency increases from improvements in irrigation and literacy were larger, the potential gains from health were still fairly substantial.

Abedullah (2006) collected data from 100 farmers, 50 each from the districts of Okara and Kasur during the year 2002-2003 and estimated the technical efficiency in potato production by employing the Cobb-Douglas stochastic production frontier approach. The null hypothesis of no technical inefficiency in the data was rejected. The results indicated that potato farmers were 84 per cent technically efficient, implying significant potential in potato production that could be developed. By shifting the average farmer to the production frontier, the average yield would increase from 8.33 tons per acre to 9.92 tons per acre using the available resources. The additional quantity of potatoes gathered through efficiency improvements would generate ₹ 990.81 (\$16.51) million of revenue each year. Consultation with extension workers significantly contributed to the improvement of technical efficiency and implied that the extension department should be one of the major targeted variables from the policy point of view in order to improve technical efficiency in potato production.

Madau (2007) applied a stochastic frontier production model to estimate technical efficiency in a sample of Italian organic and conventional cereal farms. The main purpose was to assess which production technique revealed higher efficiency. Statistical tests on the common production function model suggested that the two cultivation methods might lie on different frontiers. Separate analyses of two sub-samples (93 and 138 observations for organic and conventional farms, respectively) found that conventional farms were significantly more efficient than organic farms, with respect to their specific technology (0.902 vs. 0.831). Analysis also estimated that efficiency plays a crucial role into the factors affecting productivity in the organic process.

Hardwick et. al (2007) measured the level and determinants of maize technical efficiency of small holder farmers using a boot strapped translog stochastic frontier that was a posteriori checked

for functional consistency. The results showed that higher levels of technical efficiency were obtained when farmers use integrated soil fertility options compared to the use of inorganic fertilizer only. With respect to the policy variables considered in the analysis, access to agricultural input and output markets, credit provision and extension services strongly influence smallholders' technical efficiency. There was a need to strengthen these public policy issues in order to effectively address the efficiency of Malawian agriculture and its impact on poverty by ensuring sustainable soil fertility management.

Ogundari et. al (2007) examined the overall efficiency of small holder croppers in Nigeria with a view to examine the productive efficiency of food crop production in the country. Data were collected from 200 farmers' selected using multi-stage sampling technique and analysed using descriptive statistics, stochastic frontier production and cost function models. The returns to scale (RTS) for the production function revealed that the farmers operated in the irrational zone (stage I) of the production surface having RTS of 1.113. The mean technical, allocative and economic efficiency of 0.733, 0.872 and 0.684 respectively were obtained from the data analysis, indicating that the sample farmers were relatively very efficient in allocating their limited resources with allocative efficiency appears to be more significant than technical efficiency as a source of gain in economic efficiency. The result of the analysis indicated that presence of technical inefficiency and allocative inefficiency had effects in the food crop production as depicted by the significant estimated gamma coefficient of each model, the generalized likelihood ratio test and the predicted technical and allocative efficiencies within the farmers.

Nitiphong (2007) measured and compared technical efficiency between conventional and certified organic jasmine rice farms. Technical efficiency was measured by Stochastic Frontier Analysis (SFA) using Cobb-Douglas and translog model with half normal distributional assumption as well as multiple regression was used for analysing factors affecting technical inefficiency. Cross sectional data was randomly obtained from 330 farms in Yasothon province, which consisted of 165 conventional farms and 165 certified organic farms. Data was collected in the crop year 2005/06. According to the results, labour, seed, and organic fertilizer were much more important factors on organic jasmine rice production than on conventional one. On the average, organic farms operate closer to production frontier than conventional farms do or equivalently organic farmers were using their available resource more effectively than their conventional counterparts. In addition, on average,

conventional and certified organic farms can reduce their input use by 55 per cent and 28 per cent or could increase their output by 29 per cent and 13 per cent, respectively. Based on elasticities of variables, the key factors affecting technical inefficiency on conventional farms were management characteristics, input and knowledge on agriculture supported by government, location, and agricultural training. In case of organic farm, the key factors were management characteristics, agricultural training, education, location and farm management.

A study by Amadou, (2007) indicated that conventional Arabica coffee growers in Cameroon had educational level with a negative and significant effect on technical inefficiency. This result showed that farmers who have spent many years in formal education tend to be more efficient in coffee production. Access to credit had also a negative influence on technical inefficiency. Actually, it reduces the financial difficulties farmers face at the beginning of the cropping year, thus enabling them to buy inputs.

Bayramoglu (2008) used data envelopment analysis to compute overall technical and input-specific technical efficiency measures of conventional and organic raisin-producing households in Turkey. The questionnaires were applied to forty-four organic and thirty-eight conventional producers determined by stratified random sampling. For each household group the average cost efficiency and technical efficiency coefficients were determined to be 0.712 and 0.862 for organic households, while 0.844 and 0.903 for the conventional group. According to the coefficients calculated for individual and different returns to scale, it could be stated that conventional households were on average more efficient relative to their own technology.

Mbanasor et. al (2008) employed a translog stochastic frontier cost function to measure the level of economic efficiency and its determinants in commercial vegetable production systems in Akwa Ibom state, Nigeria. A multi-stage random sampling technique was used to select 150 vegetable farmers from whom input-output data and their prices were obtained using the cost-route approach. The results of the analysis showed that the mean farm level economic efficiency was about 61 per cent. The study found level of education and household size to be negative and significant at 10 per cent and 1 per cent respectively while age, farm experience, extension visit and access to credit were significant and directly related to economic efficiency at 1.0 per cent and 5 per cent levels of probability respectively. No significant relationship was found between economic efficiency and membership of cooperative organization and farm size.

Hanna (2008) tested the hypothesis of inverse relationship between farm size and productivity for Ukrainian farmers. Several approaches were applied in order to determine which factors, and in particular how land size affect farm productivity. The value of output per hectare and technical efficiency were taken as a measure of farm productivity. Technical efficiency was estimated by two methods – non parametric DEA and parametric SFA. It was found that the relationship between farm size and productivity was nonlinear – productivity raised first and then fell. Ukrainian farms were found to be highly unproductive due to inefficient use of land resources. The calculated optimum size of land plot was determined to be larger than the average actual size of own landholding, and this might be an important argument for cancelling of land selling moratorium in Ukraine.

Sirirat (2008) studied the existing rice production systems and assessed the technical efficiency, economic efficiency, and environmental efficiency of rice production systems, then investigated factors affecting the technical, economic and environmental efficiency of rice production systems in southern Thailand. Two-stage DEA methodology of efficiency analysis was focused. The two-stage DEA procedure began with calculating efficiency scores from input-oriented DEA model. Then these efficiency scores were used as dependent variables in the second stage by using the Tobit regression technique. The total of 247 rice farm household samples was randomly selected from the main rice farming area, the Songkhla Lake Basin. The empirical results showed that 17, 2 and 2 per cent of the sample farms were on the technical, economic, and environmental efficiency frontiers, respectively and the average technical, economic, and environmental inefficiency were 14, 32 and 46 per cent, respectively. Moreover, the common significant variables affecting the efficiency were soil type and rice variety. To improve the efficiency of rice farms, soil quality testing which help to improve soil quality and efficiency use of chemical fertilizers was suggested to implement while the research on new technologies: new suitable rice variety and new fertilizer products were considered as long-term policy implementation.

Rahman et. al (2009) measured technical efficiency and identified its determinants in crop production in Lafia local government area of Nasarawa State of Nigeria using a stochastic frontier production model. Double stage random sampling technique was used to select 100 crop farmers from which input-output data were collected based on 2005 cropping season. The results revealed that sixty five per cent (65 per cent) of the farmers were within the age range of 31-50 years and 67

per cent had farm size ranging from 2-4 hectares. The technical efficiency of crop production range from 32.7 per cent to 89.4 per cent with mean of 69.6 per cent. Farm size and fertilizer were the major inputs that were associated with the variation in crop output. The significant socio economic variables that accounted for the observed variations in technical efficiency among crop farmers were age, gender, marital status, household size, other occupation and land ownership. It was therefore recommended that a land redistribution policy that will increase the farm size of the farmers should be initiated. Fertilizer supply at subsidized rate to farmers in the area should be encouraged.

Constantin et. al (2009) applied a Cobb-Douglas, Translog Stochastic Production Function and Data Envelopment Analysis to estimate inefficiencies over time as well as respective TFP (Total Factor Productivity) sources for main Brazilian grain crops - namely, rice, beans, maize, soybeans and wheat - throughout the most recent data available comprising the period 2001-2006. The results indicate that, although positive changes existed in TFP for the sample analyzed, a decline in the use of technology has been evidenced for all grain crops in which it was observed a historical downfall in the use of inputs in Brazilian agriculture.

Nguyen et. al (2009) used both parametric and non-parametric approaches to estimate technical, allocative, and economic efficiencies for the agriculture production in sixty provinces of Vietnam in the period 1990-2005. Under different technology specifications, both approaches showed that the average technical, allocative, and economic efficiency estimates were not high, and there would be a large room for the studied provinces to improve their agricultural production efficiency. To examine consistency of the estimates from two approaches under different specifications of returns to scale, Spearman rank test was used, and the results indicated that parametric and non-parametric approaches provided different estimates.

Sheikh (2010) examined the significance of labour productivity and use of inputs in explaining technical efficiency of rice production in Bangladesh and found that higher labour productivity can stimulate higher efficiency gains, but increased use of inputs (except land) induces negative marginal effect on technical efficiency. While more use of land, improved seeds and fertilizers contribution to the rate of labour-productivity which induced marginal efficiency gain, any additional labour depresses this rate. Given the agricultural policy reform history in Bangladesh, the findings implied that rather than providing input subsidy or output price support, future reforms should put more emphasis on

providing incentives to enhance labour productivity and encourage formalization of the agricultural labour market.

Omonana et. al (2010) analysed the technical efficiency of cowpea production in Osun state southwest Nigeria, using the stochastic production frontier, budgetary and resource-use efficiency analysis. The marginal value products of all the resources used were less than their prices ($MVP < MFC$), indicating underutilization of resources. The economic efficiency was 1.17. The farmers' average technical efficiency was 87 per cent, which suggested an appreciable use of inputs in productivity. Analysis of efficiency using stochastic production frontier showed that farm size, seed, hired labour, family labour, fertilizer and pesticides were significant at 1per cent and some socio-economic variables using tobit regression model was found to be significantly different from zero at 1per cent for cooperative membership and farming experience.

Biswas (2010) focused mainly on the economics and efficiency of organic farming vis-à-vis conventional farming in India. Four states namely Gujarat, Maharashtra, Punjab and U.P were purposively selected for the study. Similarly, four major crops i.e., cotton; sugarcane, paddy and wheat were chosen for comparison. A model based non-parametric Data Envelopment Analysis (DEA) was used for analyzing the efficiency of the farming systems. The crop economics results showed a mixed response. Overall, it was concluded that the unit cost of production was lower in organic farming in case of cotton and sugarcane crops whereas the same was lower in conventional farming for paddy and wheat crops. The DEA efficiency analysis conducted on different crops indicated that the efficiency levels were lower in organic farming when compared to conventional farming, relative to their production frontiers. The results concluded that there was ample scope for increasing the efficiency under organic farms.

Javed et. al (2010) estimated technical efficiency and identify the determinants of technical inefficiency of rice-wheat farming system in Punjab during the year 2007. For this purpose a non-parametric data envelopment analysis (DEA) technique was applied. Tobit regression model was estimated to investigate determinants of technical inefficiency of the system. The results revealed that mean technical efficiency of the system was 0.83, with minimum level of 0.317 and maximum of 1. This indicated the existence of substantial technical inefficiency in rice-wheat system in Punjab. The study further revealed that if sample farms in rice-wheat system operated at full efficiency level, these could reduce their input use by 17 per cent without any reduction in level of output and with existing

technology. Results of the Tobit regression model showed that years of schooling, number of contacts with extension agents and access to credit variables had negative impact while farm size, age of farm's operator and farm to market distance had positive impact on technical inefficiencies of rice-wheat system in Punjab. It was suggested that government should focus on attracting young and educated people in farming by providing incentives in the form of soft loans.

Himayatullah et. al (2011) measured productive efficiency of tomato growers in village Akbarpura of District Nowshera in Khyber Pakhtunkhwa (KPK) province of Northern Pakistan. The study used household level data collected in summer 2010 from sample farmers selected by multi-staged sampling. The study uses a theoretical framework to measure productive efficiency and estimated the Cobb- Douglas frontier production and cost models. The study found that technical efficiency indices varied significantly, with technical efficiency index averaging at 65 per cent. The indices of allocative efficiency also varied widely, with an average of 56 per cent. There was a wide gap between the highest and lowest economic efficiency indices, with a mean economic efficiency of 35 per cent. The study concluded that farmer education, extension visits, age and access to credit contributed significantly and positively to productive efficiencies.

Susan (2011) determined the technical and allocative efficiency of small holder maize farmers in Zambia using a non-parametric method of estimation, the Data Envelopment Analysis. It further linked the observed efficiency or inefficiency to farmer's socio-economic characteristics through regression analysis. The results indicated very low levels of technical and allocative efficiency among small holder maize farmers. Technical efficiency scores ranged from 0.0005 through 1 while allocative efficiency ranged between .0005 and 1. Average technical efficiency stood at 15 per cent with only 0.23 per cent of the farmers being efficient and allocative efficiency stood at 12 per cent with only 0.27 per cent of the farmers being efficient. This meant that on an average, the level of inputs could be reduced by 85 per cent while costs could be reduced by 88 per cent without reducing output. The results also showed very low utilization of chemical fertilizers despite its positive influence on technical efficiency. Less than half (42 per cent) of the farmers captured in the survey used chemical fertilizer while 6 per cent used organic fertilizers and 7 per cent used both chemical and organic fertilizers. Use of hybrid seed, farm size and household size, access to extension services and education attainment of household head were significant determinants of economic efficiency.

Involvement in community agricultural activities, use of organic or chemical fertilizers and livestock ownership significantly reduced technical inefficiency among farmers.

Zahidul (2011) empirically examined the technical, economic and allocative efficiency of agricultural microfinance borrowers and non-borrowers in rice farming in Bangladesh using Data Envelopment Analysis (DEA) of survey data obtained in 2009. Inefficiency effects were modeled as a function of farm-specific and institutional variables. The mean technical, allocative, and economic efficiencies were found to be 72 per cent, 66 per cent, and 47 per cent respectively in the pooled sample under variable returns to scale specification. This indicated the existence of substantial gains in output and/or decreases in cost in the study areas. Results revealed that after effectively correcting for sample selection bias, land fragmentation, family size, household wealth, on farm-training and off-farm income share were the main determinants of inefficiency. Efficiency scores between microfinance borrowers and non-borrowers were significantly different which was also confirmed by the non-discretionary DEA model. This study also revealed that excess costs owing to inefficiencies was 53 per cent and concluded that main challenge faced by rice farmers in Bangladesh was to develop their cost minimizing skills. Some indicative policy guidelines to improve efficiencies were also suggested.

Stefan et. al (2011) estimated a quadratic stochastic frontier production function to examine the determinants of technical efficiency in rice farming in Bangladesh. Primary data was collected using multi-stage random sampling technique from twelve villages in north-central and north-western regions in Bangladesh. Rice cultivation displayed much variability in technical efficiency ranging from 0.16 to 0.94 with mean technical efficiency of 0.83 which suggested substantial gains in output with available resources and existing technologies. The analysis of the determinants of technical efficiency revealed that the age and education of the household heads, availability of off-farm incomes, land fragmentation, access to microfinance, extension visits, and regional variation were the major factors that caused efficiency differentials among the farm households studied. Hence, the study proposed strategies such as providing better extension services and farmer training programs, ensuring access to agricultural microfinance, reducing land fragmentation and raising educational level of the farmers to enhance technical efficiency.

Benjamin (2011) applied the cost approach constant returns to scale and variable returns to scale data envelopment analysis models to evaluate farm resource management of Nigerian farmers

using 393 rural farmers in Benue State. Scale efficiency among the respondents varied substantially ranging between 0.002 and 1.00, with a mean scale efficiency of 0.70. The study showed that some of the decision-making units had scale inefficiency, suggesting that the decision-making units were not at all operating at the optimal scale. Most of the respondents operated very far away from the efficiency frontier. The overall technical inefficiency among the respondents resulted more by scale inefficiency compared to pure technical inefficiency. Allocative inefficiency was worse than technical inefficiency, implying that the low level of overall economic efficiency was the result of higher cost (allocative) inefficiency and scale inefficiency (operating at less than optimal scale size). Solving allocation and scale problems was critical for improving farm resource use efficiency of Nigerian farmers.

Rahman (2012) conducted a study in the year 2008-09 to estimate the farm-size-specific productivity and technical efficiency of all rice crops in Bangladesh. Farm-size-specific technical efficiency scores were estimated using stochastic production frontiers. There were wide variations of productivity among farms, where large farms exhibited the highest productivity. Gross return was the highest for small farms and net return was the highest for marginal farms. The lowest net return or the highest cost of production was accrued from both the highest wage rate and highest amount of labour used in medium farms. The marginal farms experienced the highest benefit-cost ratio (BCR) followed by small and medium farms. Average technical efficiency for large, medium, small, marginal and all farms were 0.88, 0.92, 0.94, 0.75 and 0.88 respectively. There were significant technical inefficiency effects in the production of rice for marginal farms only. On an average, farmers could increase 12 per cent output with existing inputs and production technology. Fertiliser, manure, irrigation cost, insecticide cost, area under production and experience were important factors to increase production. In the technical inefficiency effect, age, education and family size had positive impact on efficiency effect, whereas land under household had negative impact on efficiency effect.

Orewa et. al (2012) measured technical efficiency of yam farmers in Edo State using the Stochastic Frontier Production Model. A multi-stage sampling technique was employed to select the 180 yam farmers used for the study. The result of the study revealed that the technical efficiency of the farmers ranged from 0.001 – 96.50 per cent with a mean of 69.32 per cent. This indicated ample opportunity for the farmers to increase their productivity through improvement in their technical efficiency. Farm size, fertilizer and labour were found to be statistically significant and positively related

to farmers output while educational level, household size and farming experience of the respondents negatively influenced farmer's technical inefficiency. The farmers therefore need to increase their output through more intensive use of land and fertilizer input.

Poudel (2012) used Data Envelopment Analysis (DEA) approach to estimate technical efficiency and followed by regressing the technical efficiency scores to farm specific characters under tobit regression model. Primary data was collected using random sampling technique from 240 (120 each) coffee famers in Nepal. Mean technical efficiency score was 0.89 and 0.83 in organic and conventional coffee farming respectively. Farms operating under constant return to scale (CRS), decreasing return to scale (DRS) and increasing return to scale (IRS) were 31.67, 3.83 and 37.5 per cent respectively in organic coffee and 29.17, 25 and 45.83 per cent respectively in conventional farming areas. Tobit regression showed the variation in technical efficiency related to education, farm experience and training/extension services and access to credit. Farmers would reconsider the rationing of input and learn from technically efficient farm practices. Policy implication would rest on production planning strategy.

Fadil (2012) attempted to study the production efficiency among rice farmers in Brunei using a stochastic profit frontier and inefficiency effects model, analysed from its three components - technical, allocative and scale efficiencies. Empirical result showed that mean profit efficiency score was 80.7 per cent and 19.3 per cent of profit was lost due to a combination of technical, allocative and scale inefficiencies with average profit-loss of \$987.50. Factors that were related to profit-loss and profit inefficiency were non-membership of cooperative, no irrigation, lack of training and low yield variety.

Sicelo et. al (2012) aimed at estimating technical efficiency of maize production and determining the factors affecting technical efficiency in Swaziland, Africa. The stochastic frontier approach was used to estimate the technical efficiency of 127 farmers and the two-limit Tobit model was used to determine the factors affecting technical efficiency of the farmers. The results revealed that there was a wide variability in the production of maize since technical efficiency ranged from 14.5 to 93.3 per cent with a mean of 80.0 per cent. The most important contributors to the maize production process were the amount of seeds, fertilizer, pesticides and labour used per hectare. Technical efficiency was found to be positively associated with farmers' age, having off-farm income, farmers' experience, inter-cropping and use of hybrid seeds. The gamma, (γ), was 68 per cent and

significant at 1per cent indicating that the variation in maize output was due to factors within the control of the farmers. It was recommended that the government needs to provide input subsidies so that farmers could use more inputs to improve their technical efficiency.

Lema (2013) compared economic efficiency of organic and conventional coffee farming system in Moshi rural district in Tanzania. The main objective of the study was to examine and compare economic efficiency of organic and conventional coffee farming systems. The data related to input and output prices, production factors and socio-economic characteristics were collected from 115 coffee farmers following both farming systems in Moshi rural district in Tanzania. The profit function approach was used in this study. Analytical tools included descriptive statistics and seemingly unrelated regression. The study results revealed that the cost of physical input of organic coffee per acre was 45 per cent lower than that of conventional coffee while the gross profit received from organic coffee farms per acre was 65 per cent lower than that obtained from conventional coffee farms. Based on Cobb-Douglas profit function estimation, coefficient of land, capital, extension services and education was found to be positive and statistically significant in the profit function model. Efficiency analysis conducted by using profit function, jointly estimated with wage share equation indicated that, economic and technical efficiencies were in favour of conventional farms. Irrespective of the disadvantages found in organic coffee farming technology, it was necessary to narrow down its technological gap when compared to conventional farming.

Audu (2013) carried out a study in Kogi State of Nigeria in 2011 using 360 small scale cassava farmers for the study. The data were analyzed with the use of stochastic frontier Cobb-Douglas cost function. Results indicated that all the cost elements included in the cost function positively influenced the total cost of cassava production and the influence of each was statistically significant at the 1 per cent level of probability. Age of the farmers, educational attainment of the farmers, household size, farming experience, extended visit, access to credit and membership of farmers association were significant determinants of cost efficiency at different levels of probability. Recommendations were made to enhance cost efficient cassava production to include provision of farm inputs to the farmers at cheap prices, provision of transport facilities for easy transportation of farm inputs and outputs and encouraging youths to stay in the rural areas to provide labour for cassava production.

Rangalal (2013) empirically estimated the technical efficiency scores and the factors of inefficiency of the 200 farm households of paddy production in the study area in Odisha by applying Frontier production function. The joint estimation of the parameters of the production function and inefficiency function suggested that 99 per cent of the variation in the efficiency was due to technical efficiency. The mean technical efficiency of 97.04 per cent implied that there was possibility of improvement in efficiency and the experience, high school as well as college education positively contributed in improving the technical efficiency.

Elhendy et. al (2013) applied the Data Envelopment Analysis (DEA) models to evaluate conventional and organic date farms resource management of Saudi farmers using 126 and 94 rural date farmers at conventional and organic farms respectively. Technical, and cost efficiencies among the respondents varied substantially ranging between 0.08 and 0.54, for technical efficiency, and ranging between 0.20 and 0.15 for cost efficiency at conventional and organic date farms respectively. A mean scale efficiency of 0.39 and 0.27 were estimated for conventional and organic date farms. The study showed that some of the decision-making units have scale inefficiency, suggesting that the decision-making units were not at all operating at the optimal scale. Most of the respondents operated very far away from the efficiency frontier. The overall technical inefficiency among the respondents resulted more by scale inefficiency compared to pure technical inefficiency. Allocative inefficiency was worse than technical inefficiency, implying that the low level of overall economic efficiency was the result of higher cost (allocative) inefficiency and scale inefficiency (operating at less than optimal scale size). Solving allocation and scale problems was critical for improving date farm resource use efficiency of Saudi date farmers.

Gupta et. al (2013) measured farm level technical efficiency for paddy in Hailakandi district of Assam on the basis of farm level primary data of 265 cultivators for the cropping season of 2010-11. A translog stochastic production frontier was estimated and selected non-input factors were assumed to explain farm level variations in technical inefficiency. Among the non-input factors age and education levels of the cultivator had positive influences on technical efficiency. However indebtedness and percentage of self consumption of farm turn out had negative influences. Government support through agricultural department had an insignificant impact on technical efficiency. Proportion of land leased in by the cultivator had a positive impact on technical efficiency. Decreasing returns to scale was apparent from the parameter estimates. Mean technical efficiency

was found to be around 63 per cent. The study observed negative association between farmers' distress and the level of technical efficiency.

Hidayah (2013) determined the level of production and cost efficiency on paddy farming system with integrated plant and resource management (IPRM) approach in Buru District Maluku Province, Indonesia. Maximum Likelihood Estimation (MLE) method was used to estimate parameters. 120 respondents were selected by using simple random sampling method. The empirical finding showed that the error term was mostly influenced by inefficiency factors (γ production = 0.933; γ cost = 0.948) rather than stochastic factors. The average technical efficiency was 0.855 and 75.83 per cent respondent already operated in this level of efficiency. The average cost efficiency was 0.86 and 80 per cent of respondents already achieved this level of cost efficiency. These findings indicated that rice farming system with integrated plant and resource management approach in the research area was efficient and profitable.

Earfan et. al (2013) used stochastic frontier production function to analyse the resource use efficiency of farmers in Bangladesh. The result showed that 76 per cent of farmers were 70 per cent efficient, of which maximum efficiency was 0.92, while minimum efficiency in farm was 0.45.

Girei et. al (2013) assessed the resource use efficiency of Fadama II beneficiary crop farmers in Adamawa state, Nigeria. Data were collected from a sample of 160 farmers and were analyzed using stochastic frontier production function. The stochastic production function results showed that the coefficients of farm size, inorganic fertilizer, hired labour and expenses on ploughing, significantly affected food crop output of the respondents. The mean technical efficiency was 0.71 (or 71 per cent), the mean allocative efficiency was 0.76 (or 76 per cent) and the mean economic efficiency was 0.54 (or 54 per cent).

Anyanwu (2014) compared allocative efficiency among small holder farmers who practiced low external input technology [LEIT] and high external input technology [HEIT] agriculture in Imo State, Nigeria. Cross sectional data generated from 160 small holder farmers randomly selected from 2 out of the 3 agricultural zones in Imo state were used. Production function was used in analyzing the data. Results showed that resources such as farm lands, labour, planting materials, capital and organic manure or inorganic fertilizer were underutilized among LEIT and HEIT farmers. Comparatively, LEIT farmers achieved higher allocative efficiency in the use of land (32.71) than HEIT (37.25). HEIT farmers on the other hand, achieved higher allocative efficiency in the use of planting

materials (1.275) and inorganic fertilizer (1.097) than LEIT farmers. Appropriate policies such as credit liberalization, re-examination of existing land laws should be put in place by the government to enable these farmers have access to purchased inputs and to optimally allocate them in their farms.

C. Costs and returns of Organic/Inorganic farming system

Lockeretz *et. al.* (1978) has compared the economic performance of 14 organic crop/livestock farms in the Midwest with that of 14 conventional farms. The farms under study were paired based on the physical characteristics and types of farm enterprises. The market value of crops produced per unit area was 11 per cent lower on the organic farms. But since the cost of production was also less, the net income per unit area was comparable for both the systems.

Berardi (1978) had compared 10 organic and 10 conventional farms in New York and Pennsylvania for returns from wheat production only. When cash operating costs alone were included, the returns were higher on the organic farms. However, when the costs of land and unpaid family labour were included, the conventional farms had a higher average net return. However, the above studies had several limitations. The most obvious was the small sample size, which made it difficult to conduct any statistical test of differences. The averages did not reflect the high variability that occurred in both yields and net returns on both types of farms.

Roberts *et. al* (1979) has compared data from 15 organic farms in the western corn belt with the USDA data on representative conventional farms in the same area. In most cases, the net returns were higher on the organic farms. Both the studies had shown that production costs were lower on the organic farms.

Eberle and Holland (1979) made a comparison between organic and conventional farms in Washington and found that net income per unit area was 38 per cent higher on the conventional farms. However, the author of a follow-up study of six organic farms has found that net returns on organic farms were 22 per cent higher than on the representative conventional farms.

Rozyspal *et. al* (1993) compared economics of US winter wheat and spring barley production in organic and conventional farming in first and second years of the conversion to organic farming and concluded that the net income per hectare was higher in organic farming compared to conventional farming.

Anderson *et. al* (1994) examined different research studies conducted on organic farming in USA. They concluded that the lower yields on organic farms contrasted with conventional farms were

balanced by lower production costs. The noted differences between economic performances of organic and other farms may be due to farm size rather than farming system. During the study period, the US organic producers did not receive any benefit from the environmental advantages except to the extent that consumer willing to support by paying a premium.

Wynen (1994) carried out a review study on organic farming in Australia. He concluded that the wheat yields were almost similar between organic and conventional farms. The study also indicated that the variability of wheat yields on organic farms was lower than on conventional farms. The financial results of two groups of farmers per hectare were remarkably similar.

Lampkin (1994) summarized various studies conducted on economics of organic farming in different crops in South and West of England and parts of Scotland and Wales. It was concluded that the organic farming systems were more diverse in terms of enterprise mix; have lower yields and higher labour costs which were not compensated for fully by reduced input costs. Higher/premium prices were essential if organic farmers were to achieve similar incomes to their conventional counterparts.

Padel and Uli (1994) reviewed several studies on costs and returns of organic farming in various crops in Germany. Their study revealed that the organic farming under German conditions was equally profitable with conventional farming. Lower yields for arable crops were compensated by reduced costs of inputs and premium prices for most of the crops. Many farmers' explained that financial stability was the main reason for converting to organic farming. Introduction of support schemes for conversion and continuing organic farming also made a significant impact on the profitability.

Dubgaard (1994) studied the economic analysis of organic farming in Denmark. The results showed that the yield differences were most noticeable for intensive crops such as wheat and potatoes with organic yields around half the conventional averages. The organic farms used about twice as much labour per hectare as the conventional farms. The study also concluded that the substantial price premiums on output and public support were essential for the economic viability of organic farming in Denmark.

Krishnamoorthy (1995) studied the economics of organic manures, Azospirillum and chemical fertilizers application to kharif sorghum in transitional tract of Karnataka. The higher net returns of ₹ 11501 were obtained with application of vermicompost + Azospirillum + 100 per cent RDF

(recommended dose of fertilizers) followed by Azospirillum + 100 per cent RDF ₹ 10934 and FYM + Azospirillum + 100 per cent RDF ₹ 10668 respectively. But Benefit : Cost ratio in vermicompost + Azospirillum + 100 per cent RDF application was lower (1.01) than the application of FYM + 100 per cent RDF (1.34), Azospirillum + 100 per cent RDF (1.63) and FYM + Azospirillum + 100 per cent RDF (1.25). High cost of vermi-compost increased the cost of cultivation and subsequently reduced the net returns. The study indicated that the combined application of organic and inorganic fertilizers found to be beneficial than the individual application.

Huchhappalavar (2001) conducted a study on performance of organic farming in Shimoga district of Karnataka. He identified types of organic farming systems practised by farmers for paddy and sugarcane cultivation. The organic farmers obtained 21.93 per cent of higher yield of paddy and 18.10 per cent higher yield of sugarcane over the inorganic farms. The average cost of cultivation per acre of paddy and sugarcane worked out to be lower in organic farms compared to inorganic farms. The per acre gross returns from both the crops were higher on organic farms compared to those on inorganic farms with a positive net returns on both the categories of farms. The returns per rupee spent in paddy and sugarcane production were ₹ 2.06 and ₹ 2.04 on organic farms, respectively compared to ₹ 1.61 and ₹ 1.71 on inorganic farms respectively.

Kathleen et. al (2003) examined the agronomic and economic performance of conventional and organic systems in Iowa, using certified organic production practices. They reported the results of the economic analysis from three years of production (1999–2001). Returns for corn within the organic corn-soybean-oat and corn soybean- oat-alfalfa rotations were significantly greater than conventional corn-soybean rotation returns at \$51/acre. Corn returns were not significantly different between the two organic rotations at \$264/acre and \$272/acre, respectively. Returns for soybean within the organic corn-soybean-oat and corn-soybean-oat-alfalfa rotations were not significantly different at \$470/acre and \$505/acre, respectively. Organic soybean returns were significantly greater than conventional soybean crop returns (\$95/acre) in the corn-soybean rotation.

Daniel (2005) compared cotton yields, profits and pest incidence at fields of farmers partaking in an export oriented organic cotton production program with yields of conventional cotton production in Karim nagar, Andhra Pradesh during a bad cotton season (2004). Late season drought reduced actual yield by 42 per cent compared to the estimated yield in October, 2004 and usual average yields. Organic cotton yielded on par at 232 Kg seed cotton /acre against conventional cotton

at 105 Kg/acre. Organic cotton was more profitable at plus ` 559/acre (approx. US \$ 13) versus minus ` 1307/acre (minus US\$ 30) in conventional cotton. Pest control in organic cotton was about ` 220 (US \$ 5) per acre (5 per cent of total production costs of organic cultivation) as against ` 1624 (US \$ 37) per acre (30 per cent of total production costs of conventional cultivation) in conventional cotton.

Fasoranti (2005) studied the determinants of agricultural production and profitability with special reference to maize production in Akoko North East and South West Local Government Areas of Ondo-State. Data collection was done through well structured questionnaire administered on 100 respondents selected through random sampling technique. The method of analysis used were descriptive statistics, gross margin analysis and production function analysis using the Ordinary Least Square (OLS) criterion to estimate the parameters of the production function. Results showed that majority of the farmers were ageing and quite experienced in maize farming. Also there was high level of illiteracy as about 65 per cent of total respondents had no formal education while 25, 6 and 4 per cent had primary, secondary and technical education respectively. Farming was majorly on subsistence level as the mean farm size was 0.39 hectares. Maize farming was profitable in the study area with gross margin and net returns of ` 2,637.80 and ` 2,141.00 respectively. Results showed that farm operation was in stage II of the production function with RTS estimated as 0.62 and factors of production were efficiently allocated with elasticities that were positive but less than one. Results further showed that age, education, labour and cost of non-labour inputs were positively related to output while farm size and years of experience carried negative signs. However, only labour input has significant influence on output.

Jitendra et. al (2006) made an attempt to study the adoption and awareness of organic farming as well as costs and returns of major crops grown under organic farming vis-à-vis non-organic farming on a sample of 90 farmers (45 organic and 45 non-organic) selected from the Kashipur block of Udham Singh Nagar district of Uttaranchal during the year 2004-05. The study has revealed a fairly good adoption status with 36.51 per cent of sample farmers engaged in organic farming. Cost of cultivation for organic paddy has been found as ₹ 18786/ha and ₹ 31651/ha and for non-organic paddy as ₹ 19106/ha and ₹ 35947/ ha. The yields from organic and non-organic paddy have been found as 26.86 q/ha and 32.74 q/ha, respectively. However, farmers could realize relatively higher prices for organic (₹ 1380/q) than non-organic (₹ 1161/ q) paddy. Net returns from organic and non-organic paddy have been found as ₹ 20144/ha and ₹ 7279/ha and ₹ 21323/ha and ₹ 4483/ha,

respectively. The wheat yield has been found to be lower for organic (19.85 q/ha) than non-organic (28.12 q/ha) farming. The difference between prices of organic (₹ 875.16 /q) and non-organic (₹ 780.24 /q) wheat had not been much wide. Hence, organic paddy has been found more profitable than organic wheat. The study has suggested organization of training programmes to generate awareness regarding organic farming. Lack of inputs being a general problem among producers, government should ensure timely delivery of quality inputs at reasonable costs. Also, to encourage organic farming, market support system need to be strengthened.

Shirsagar (2008) studied the impact of organic farming on economics of sugarcane cultivation in Maharashtra. The study was based on primary data collected from two districts covering 142 farmers, 72 growing organic sugarcane (OS) and 70 growing inorganic sugarcane. The results concluded that OS cultivation enhances human labour employment by 16.9 per cent and its cost of cultivation was also lower by 14.2 per cent than inorganic farming. Although, the yield from OS was 6.79 per cent lower than the conventional crop, it was more than compensated by the price premium received and yield stability observed on OS farms. Overall, the OS farming gave 15.63 per cent higher profits than inorganic farms.

Toranne (2009) in North Konkan region of Maharashtra state selected 360 farmers from small, medium and large group farmers which revealed that balanced use of fertilizers and judicious use of labour was required to be cost-effective. The use of FYM and organic fertilisers should be increased. Allocation of resources and re-arrangement of enterprises had greater scope in majority of farming systems. The supply of good quality seed, establishment of crop specific co-operative marketing arrangements, network of ware-houses were some of the measures suggested to facilitate and regulation of market practices in adoption of the farming systems.

David (2009) evaluated crop budgets from two Pennsylvania organic farms as case studies. A critical component of these budgets was the calculation of costs related to cover cropping, rotations, and compost production or use. These farms were very different in their scale, management, and marketing strategies. The crops selected for study on each farm were also different, based upon economic value to the farm. Beech Grove Farm used horse traction and hired no production labor on about 4 acres of production; budgets for carrot, onion, and garlic were presented. The other, Spiral Path Farm, used machinery and a hired labor crew extensively on about 60 acres; their production costs for tomato, lettuce and winter squash were presented. While costs could not be compared

between the farms, costs per acre varied widely among crops on a farm, but less so across years. Neither farm spent a great deal on pest control inputs, relying on soil fertility and other management practices to minimize infestations and grow healthy plants. While these single-crop budgets provided some realistic measures of costs of organic vegetable production, long-term budgets measuring multi-year rotations would better capture the tradeoffs made by diversified organic farmers.

Karki et. al (2011) investigated factors that determined the conversion to organic production using Nepalese tea producers as a case study. A survey of 181 farmers was conducted in the Ilam and Panchthar district of Nepal, among which 86 were organic farmers and 95 were conventional farmers. A discriminant analysis was used to identify socio-economic characteristics that distinguish conventional and organic farmers. Results from the estimated discriminant function suggested that farmers located in a distance from regional markets, older in age, better trained, affiliated with institutions and having larger farms were more likely to adopt organic production. Similarly, environmental awareness, bright market prospects, observable economic benefit and health consciousness were the major factors influencing farmers' decisions on the conversion to organic production. While planning programs for the development of the organic tea sector in Nepal, policy makers should consider the support of farmers' institutions, provision of training to farmers and raise farmers' awareness about the environmental, economic and health benefits of organic farming.

Wuttipong (2011) examined technical efficiencies by using the stochastic frontier production function approach for Asian countries for the period 1961-2004. A translog production function was used to represent the gross production of agriculture in selected countries. The results showed that the estimated elasticity of gross production with respect to labour was 0.61 compared to 0.21 in case of time trend but labour appeared to be the most important factor of gross production. This means that for a 10 per cent increase in the number of labour, gross production would increase by 6.1per cent. For estimated stochastic frontier model in case of with time trend or technical change, the input elasticity for land slightly decreased to 0.47. However, land elasticity of 0.47 was the highest effective component to increase gross production in Asian countries.

Govind et. al (2012) made an attempt to examined the cost and return analysis of organic and inorganic farming practices for paddy cultivation in Jabalpur district of M.P. The findings of the study revealed that on an average the total cost of cultivation (Cost C3) of paddy under organic and inorganic were observed to be ` 8521 and ` 14324 respectively. The average yield per hectare of

paddy crop was found maximum among inorganic farms (21.92q/ha) against 14.88 q/ha organic farms. Medium farmers harvested maximum yields of paddy under both the situations and lower yields was found in large farms. The price of organic paddy was found relatively higher than inorganic paddy in the study area. Net income and output-input ratio was higher among organic farm. Thus, incremental net income was only ` 2186 per ha realized from organic farming and it was economically viable and profitable over inorganic paddy farming in the study area. Net income on different farm size in organic situation ranged from ` 8203 to ` 10122 and ` 6067 to ` 8249 per ha in case of inorganic paddy. They suggested that sincere efforts be made by the extension personnel to motivate the farmers to adopt improved production technology to minimize the yield gap.

Siddaraju et. al (2013) analysed the economic performance of organic agriculture and modern agriculture systems in India and compared them. The study revealed that farm business income from organic agriculture was greater than that from modern agriculture in the case of coconut, arecanut, paddy and sugarcane.

Mohanasundari (2013) conducted a study about the cost and returns from the cultivation of sugarcane in Namakkal district and 50 farmers were approached to find the details regarding the sugarcane production. The results showed that the cost of production of sugarcane per acre was ` 29550. The average yield was estimated at 100 tons per acre. Average price per ton of sugarcane was calculated at ` 1000. The results also showed the maximum share of land and efficiency gain in production in terms of labour under new production technology.

Padma et. al (2014) determined the major common factors influencing the land productivity of Vellore region located in the state of Tamil Nadu, India across organic and inorganic cultivation and suggested some policy measures to promote organic farming. The sample size consisted of farmers adopting 23 organic and 20 inorganic farming systems. Discriminant analysis was carried out to analyse the data. It was found that land size, number of labourers employed, number of implements used and output were the highest discriminating variables. It was suggested that there was more scope for organic farming with proper training and knowledge through research. Organic farmers were best practitioners as well and they realized greater average yields.

Debnath et. al (2014) made an attempt to study the traditional farming practices of Dhalai in Tripura during 2012-13 for seven farming systems viz. paddy, vegetables, fruit crops, fishery, piggery, dairy and rural poultry. Economic analysis of various farming systems using benefit cost ratio revealed

that the productivity and profitability of all the seven components were found to be marginal but sustainable when compared to capital intensive approaches. The study indicated that traditional farming practices were excellent approach for family nutrition, income and employment generation for the rural farmers of Dhalai. Besides, these practices were sustainable in terms of land use pattern, utilisation of locally available materials, family labour, and money without any specialised skills, these practices could easily be practised.

Singh et. al (2014) conducted research on organic farming at G.B.Pant university of agriculture and technology since 2004-05 to find out the effect of organic, chemical and integrated mode of cultivation on soil, environment and productivity and to develop organic package and practices for different crops and cropping system. The study revealed highest grain yield of wheat was recorded in organic mode of cultivation in the year 2010-11. Economic analysis of different cropping systems revealed that during the years 2006-07, 2007-08 and 2010-11, highest net return and B: C ratio was recorded in organic mode of cultivation.

D. Constraints and opportunities in farming system

Khanna (1983) observed that in northern region of India, general resource base of the farmers had been low. The low income prevented the farmers from investing in soil and plant protection. Due to overgrazing and reckless deforestation, soil erosion and landslides had emerged as a serious problem in hills. He further revealed that lack of cheap and adequate means of transportation and extremely small size of holdings which did not allow the full capacity use of resources. Non availability of even a pair of bullocks was also a main problem of farming in hills.

Thakur and Sharma (1985) had shown that the main bottleneck faced by the farmers in Himachal Pradesh was marketing, that was both for the purchase of inputs required by them and the sale of their output. The results of their study showed that the establishment of Himachal Pradesh market committee had some beneficial impacts, protecting the farmers from the proverbial exploitations by the traders

Rangaswamy (1986) pointed out the constraints for dry land farming areas in India were availability of quality seeds, fertilizers and pesticides. He revealed that the farmers were uncertain about the outcome of crops and farmers felt that they would loose less by investing less. He stressed the need for developing suitable strategies to stabilize the farm income in dry areas.

Abdul and Rao (1987) observed that the modern inputs like tractors, fertilizers and pesticides in India were distant fruits for the subsistence small farmers due to their social and economic backwardness. They pointed out that the green revolution had benefited mainly the landlords. They suggested that liberal credit facilities, subsidies on costly inputs and group efforts to own the costly farm implements jointly could improve the farming systems.

Chitinis and Bhikgaonkar (1987) investigated the major constraints that caused technological gaps in the process of adoption of dry farming technology in India. Four types of constraints were identified namely (i) technology, (ii) credit and economic service (iii) supply and (iv) information transfer. They firmly advocated the adequate supply of inputs, timely advice and training through demonstrations.

Kaushik (1997) analysed the issues and policy implications in the adoption of sustainable agriculture in India. The concept of trade off had a forceful role to play in organic farming both at the individual and national decision making levels. Public vis-a-vis private benefits, current vis-a-vis future incomes, current consumption and future growths, etc. were very pertinent issues to be determined. The author also listed a host of other issues. While this study makes a contribution at the conceptual level, it has not attempted to answer the practical questions in the minds of the farmers and other sections of the people.

Naik (1998) while studying economics of farming systems in Uttar Kannada district, Karnataka identified the problems faced by the farmers in all the three agricultural regions of the district. He classified the problem broadly into, production, financial, marketing and extension problems. The major problems faced by the farmers in the production front were shortage of labour during peak season, timely non-availability of chemicals and fertilizers and non-availability of improved breeds of livestock. Exploitation by commission agents and traders were the major constraints under marketing while, lack of extension and training facilities was the main constraint among the infrastructural or extension constraints.

Vivekananda (1999) attempted to study the problems and prospects of agricultural development in Karnataka. He opined that agricultural development in the state had been hindered by the problems such as, weak input research, weak extension network, regional imbalances, stagnation in area under HYV's etc.

Ganesh (2000) classified the problems faced by the farmers under four groups viz., production, financial, infrastructural and marketing in Gazani lands of Karnataka. With respect to the production problems, majority of the farmers complained about non-availability of better variety seeds. Regarding financial problems, lack of funds for purchase of improved inputs, extension problems included non-availability of package of practices. The important problem was absence of market regulation and information.

Gavisiddappa et. al (2001) identified the problems in agricultural production and trade in Haveri district of Karnataka. The sample farmers were unanimous and cent per cent in their opinion with respect to non-availability of seeds, unawareness potentiality of crop, lack of irrigation facilities, pest and diseases, lack of cheap labour, no market in India and no storage facilities of refrigerated rooms. Irregular payment made by the company (30 per cent) and lack of research support regarding the crop (34 per cent) were some other problems.

Sankaram Ayala (2001) was of the view that almost all benefits of high yielding varieties based on farming accrue mostly in the short term and in the long term. They cause adverse effects. There was an urgent need for a corrective action. The author ruled out organic farming based on the absolute exclusion of fertilizers and chemicals, not only for the present, but also in the foreseeable future. There ought to be an appropriate blend of conventional farming system and its alternatives. The average yields under organic and conventional practices were almost the same and the declining yield rate over time was slightly lower in organic farming. The author also quoted a US aggregate economic model, which showed substantial decrease in yields on the widespread adoption of organic farming. Decreased aggregate outputs, increased farm income and increased consumer prices were other results.

Rajkumar and Harisingh (2002) studied problems in vegetable production in bharatpur district of rajasthan. The problems reported were poor quality seeds, insufficient availability of seed, high cost of seed and non-availability of seed at appropriate time, insufficient availability of irrigation water and lack of farm yard manure.

Basavaraj and Kunnal (2002) identified the constraints in production, marketing and processing of soyabean in Belugum district of India. It was observed that severe problem faced by growers was rust disease leading to heavy loss, high labour wages and, non availability of quality seeds. In marketing, farmers experienced problem of price fluctuation, low price for the produce,

problem of transportation and delayed payment of sale when produce was sold out to co-operative society. The other problems were inadequate power supply and non-availability of labour at times faced by the processor.

Wadear (2003) pointed out the problems faced by the sample farmers in production of different crops in selected zones of northern Karnataka state. He observed problems like non-availability of seeds in time, lack of storage facility, pest and disease incidence, price fluctuation were severe in many of the crop cultivation.

Kathrina et. al (2003) made an attempt to identify problems and potential of the conversion to organic farming in South Africa from 2000 to 2002. The results revealed that the organic farming movement was in an early stage of the adoption or diffusion process of an innovation. However, the environment has to be suitable if the innovation is to be implemented as a part of the system. This requires support not only concerning technical aspects but also from socio-economic characteristics of the farmers.

Pius et. al (2006) investigated the determinants of yam production in South-eastern Nigeria using a stochastic frontier production function, which incorporated a model of inefficiency effects. Farm-level data were collected from a sample of 120 yam farmers in Enugu State and used for the analysis. The results indicated that labour and material inputs were the major factors that influenced changes in yam output. The effects of selected farmer-specific socio-economic characteristics on observed inefficiencies among the farmers were also examined. Farmer-specific variables, such as education, farming experience and access to credit, were the significant factors implicated for the observed variation in efficiency among yam producers.

Bhatta (2009) stated that increasing use of agro-chemicals, higher production cost and deteriorating ecosystem health have advocated the need to change traditional and external input use agriculture towards safe and sustainable organic production. This research focused on the constraints and opportunities of organic agriculture and consumers' awareness and willingness to pay more for organic vegetables by selecting producers from Lalitpur and Bhaktapur districts using spatial sampling and consumers from Kathmandu valley randomly. Data obtained from structured questionnaire were subjected to descriptive and econometric analysis and willingness to pay analysis. Most of the farmers interviewed were aware about the negative repercussion of the indiscriminate use of agro-chemicals. Organic vegetables were either home delivered and/or sold to the specialized niche

markets. All domestic organic products reach the consumers without labeling. Most of the organic consumers were willing to pay eight rupees more for labeled organic vegetables. Currently organic farmers rely only on consumers' willingness to pay more to obtain a compensation for lower yields. Family income, education, profession etc were key attributes of the consumers shaping their decision to buy organic vegetables. Organic industry was too small and a long way to go in Nepal. Political commitments such as avoiding conflicting drive to maximize production, hammering proactive policy, initiating organic technology research, providing market incentives and institutionalization of Nepalese organic movement were imperative to further enhance organic sector in Nepal.

Mahendra (2011) studied the yield gap and the production constraints in the rice-wheat (R-W) system in eastern Uttar Pradesh. The yield gap II (difference between the yield obtained at nearest demonstration plot and actual yield obtained on farmers' fields in a particular region) had been found 45 percent and 38 percent in rice and wheat crops, respectively, in the irrigated rice-wheat system. The technological and socio-economic constraints have accounted for 54 percent and 46 percent of the yield gap, respectively, in the system. Soil-related constraints ranked first, followed by weed-related constraints. Among the individual constraints, zinc deficiency rank first followed by nitrogen deficiency and incidence of Phalaris minor. The study has concluded that for the sustainability of the R-W system, priority should be accorded to bridge the existing yield gap through addressing the production constraints.

Neda et.al (2014) conducted a study of organic farmers in the Cameron Highlands to revealed the challenges that had been occurred with regard to adoption of the practice. The results indicated that organic farmers face challenges with regard to land tenure, certification processes, hiring foreign workers, marketing, training and extension services and governmental support.

E. Conversion from inorganic to organic farming system

Lauwere et. al.(2005) studied the motives of farmers to convert to organic farming (or not) as well as factors affecting these motives in Austria. The results were based on twenty in-depth interviews with experts in the field of organic farming. Different kind of motives to convert to integrated or organic farming can be distinguished: idealistic motives, related to the intrinsic 'drive' of farmers, economic motives, related to the financial aspects of converting, technical motives, related to matters such as the control of weed and the availability of workers and institutional motives, related to the

institutions surrounding farmers (traders of chemical crop protection products, policymakers, farmers living in the area). According to the respondents, idealistic motives were the most important reason to convert and institutional motives was the most important reason for not converting. This illustrated that it was important to involve all relevant factors when considering a conversion to integrated or organic farming. According to the respondents, the personal characteristics of farmers, such as perseverance and dealing with uncertainties, were the most important factor. Other 'internal' factors, related to the farmer were his financial scope and farm conditions. 'External' factors mentioned by the respondents were related to the economic, technical and institutional motives for converting or not. Motives for not converting to more sustainable agriculture were often related to a perceived risk or uncertainty. Involving relevant actors in the process of conversion, financial incentives, providing knowledge, consistent policy or offering farmers some room for experiments might help to reduce the perceived uncertainty. The most important conclusion was that it does not only concern the farmers who have to convert. The factors surrounding them have to join them.

Ika Darnhofer et. al. (2005) aimed to provide a detailed picture of farmers' decision-making and illustrated the choice between organic and conventional farm management. Based on 21 interviews with farmers in Austria, a decision-tree highlighting the reasons and constraints involved in the decision of farmers to use, or not to use, organic production techniques was formulated. The accuracy of the decision-tree was tested through a written survey of 65 randomly sampled farmers. The decision-tree permitted the identification of decision criteria and examined the decision-making process of farmers in choosing their farming method. It also allowed for the characterization of farmer strategies and values, identifying five types of farmers: the "committed conventional;" the "pragmatic conventional;" the "environment-conscious but not organic;" the "pragmatic organic;" and the "committed organic." The study concluded by highlighting the importance of taking into account heterogeneity in farmers' attitudes, preferences, and goals and their impact on the choice of a farming method.

Eva (2005) stated that a farm model was developed for simulating the potential income change resulting from conversion to organic farming. The model used conventional farm data, taken from the Belgian Farm Accountancy Data Network (FADN). Given the normative character of the model, and the impossibility of calibration to historical conversion behaviour, two model variants, a rigid and a flexible, were created to broaden the analysis scope. Moreover, extra attention was paid to

the verification process and sensitivity analysis. Results revealed that the economic potential for conversion was rather high, if farmers were willing to change their farm management sufficiently. Furthermore, conversion potential depended on the farm type and conventional farm characteristics.

Khaledi (2007) focussed on identifying factors that encourage or discourage farmers considering adopting organic practices, especially the institutional factors that affect the decision whether to convert to organic farming. The data used in the study were collected from a sample of both organic and conventional farmers in Saskatchewan, Canada. The results revealed that conventional farmers lack information in many areas of organic practices, and that the institutions related to organic farming were very useful in providing information about organic farming. Assessing the "willingness to convert" of conventional farmers showed some potential for converting to organic practices. Lack of knowledge and skills needed to manage an organic farm and lack of market opportunities for organic products were the most important reasons for not using organic farming practices. The survey indicated that economic factors had the greatest importance in motivating conventional farmers to convert to organic practices. Control of weeds, insects and disease, uncertainty about economic returns, and complications in the process of becoming an organic producer, appeared as the most important barriers in implementing organic farming practices. Conventional farmers identified the need for more labour as an important challenge to be faced after converting. Half of the conventional farmers surveyed believed that costs for organic products were higher than conventional products. Also, most of the farmers believed that all activities in marketing organic products had higher costs, or take more time. It appeared that conventional farmers' beliefs and attitudes were important factors in affecting their willingness to accept organic practices. Despite their concern for the environment, future generations, human health and consumer preferences, farmers on average disagreed that organic farming was the way for them to achieve these objectives. While conventional farmers showed low levels of knowledge about organic standards, the effectiveness and protection of organic regulations could encourage conventional farmers to convert to organic practices. Certification bodies can improve organic farming by increasing farmers' satisfaction with organic agriculture. Moreover, marketers have an important role in switching farmers from conventional to organic agriculture. Conventional farmers' opinions indicated that private organizations in Saskatchewan were important for the development of the organic farming sector; in this regard, private organizations may be more effective than public organizations. Conventional

farmers' views on interrelationships between organic and conventional farmers' institutions revealed a conflict in government policies between organic and conventional sectors, and also between organic and mainstream farmers. On the other hand, they revealed a co-operative relationship between organic farming and mainstream farming institutions.

Frank (2007) in a two year comparative study in central India covering 170 cotton fields, organic farms achieved cotton yields that were on par with those in conventional farms, whereby nutrient inputs and input costs per crop unit were reduced by half. Due to 10–20 per cent lower total production costs and a 20 per cent organic price premium, average gross margins from organic cotton fields were 30–40 per cent higher than the conventional system. Although the crops grown in rotation with cotton were sold without premium, organic farms achieved 10–20 per cent higher incomes from agriculture. In addition to these economic benefits, the organic farming system does not burden soil and groundwater with synthetic fertilizers and pesticides. However, in this study only minor differences were detected in soil fertility parameters of organic and conventional fields. Altogether, the results suggested that conversion to organic farming can improve livelihoods of smallholders while protecting natural resources. Income loss due to reduced yields in initial years of transition, however, constitutes a major hurdle, especially for poorer farmers. It was thus important to support farmers in overcoming the obstacles of the conversion period.

Claire (2008) in this review combined agricultural and social scientists' viewpoints for a critical appraisal of literature on conversion to organic food and farming in India. First, a brief historical retrospective enabled to refer the scientific production to the institutional and economic context over the past decades. Secondly, they reviewed the methods used to analyse conversion in agricultural and social sciences, and showed that emphasis was most often laid upon the effects of conversion and the motivations to convert, on the basis of comparative approaches with so-called conventional agriculture. Therefore, the literature minimised the importance of transitional aspects and rarely approaches conversion as a longer process than its legal duration and from a wider point of view. Thirdly, they examined the paradigms of input efficiency and system redesign, which frame discussions about transitions in agriculture, beyond organics, and therefore helps shed light on sustainability issues. They suggested that analysing conversion and more generally transitions in agriculture as multidimensional issues, involving both production and social practices, entails interdisciplinary approaches and the redefinition of some central research topics.

Lukas (2008) explored the effects of a change from conventional to organic farming had on the livelihoods of a group of farmers in Karnataka, South India. It involved semi-structured interviews with organic farmers, NGOs, consumers, marketing organisations, and the State Agricultural Department. The farmers in the case study perceived that they had improved their livelihoods over the long term by the conversion from conventional to organic farming. Reduced costs for external inputs and reduced labour requirements together with similar or higher yields and premium prices resulted in higher net-farm incomes. The conversion to organic farming reduced the reliance on credits and the risk of crop failure due to pests, diseases and droughts, thereby reducing vulnerability. In addition, the farmers mentioned enhanced natural assets, reduced risk of pesticide poisonings, improved food safety, higher levels of self-sufficiency, and the access to networks supporting knowledge exchange and political participation as important benefits of the conversion. However, almost all the case study farmers noted that the conversion period was difficult due to temporarily declining yields and a lack of information and experiences. This was likely to be a major constraint preventing asset-poor farmers from adopting organic agriculture.

Matthias (2008) examined determinants of the decision to convert to organic farming methods were examined by applying bi-variate analysis and a multi-nomial logit model to a survey of 1018 Norwegian crop and dairy farmers. The results showed that 4 per cent of the conventional respondents had plan to convert by 2009, which implied that the national goal of 10 per cent organically managed area would not be achieved. The analysis indicated that organic farmers, compared to their conventional counterparts, were more likely to had larger farms, more education, be located closer to urban areas, be crop farmers, had 'sustainable and environment-friendly farming' as a goal and hold favourable views about the values of organic farming methods. Even though the farmers who were planning to convert seem to be more business-minded and less organically oriented than the existing organic producers, policies for promoting organic farming which confined itself to financial considerations may miss important factors which prompt farmers to convert.

Sharifi (2010) tried to identify the barriers in conversion to organic farming in Babol County in Iran. A sample size of 150 farmers was selected for this research by using simple random sampling method. The result of factor analysis showed that major barriers or obstacles to the adoption of organic farming between farmers were: productive, natural, attitude and knowledge, infrastructural,

institutional and economical barriers. These factors explained about 68 per cent of the total variance of the research variables.

Natacha (2011) emphasised that organic food and farming as an alternative agri-food system among others encompasses multiple dimensions and performances, enabling the study of conversion as a prototype of transition. They used the multi-level pathways framework to describe the transition process. They first presented organic food and farming as a heterogeneous entity and examined the consequences of acknowledging its diversity. They showed that organic food and farming as an innovation influenced the mainstream design of agri-food systems, and they explored the strategies of the actors in charge of its development. They then introduced how different levels could influence types and levels of conversion, with actors who had diverse expectations to articulate. This raised the issue of time frames with short-term adaptations and long-term transitions. Finally, they introduced the market itself as a composition of sectors and territories. They argued that this diversity had to be kept beyond consensus to build multiple strategies. They represented the initiatives of different networks in their spatial and social dimensions. This begs the question of the co-existence of these models. They conclude that the policy level had a prominent role to play in enabling this co-existence.

Karbazi (2012) developed a dynamic linear programming model to analyse the effects of different limiting factors on the conversion process of farms over time. The model was developed for a typical arable farm in the Mazandaran, Iran and was based on two models, conventional and organic. The objective of the model was to maximize the net present value over a 10-year planning horizon. The data for analysis had been collected from the Agricultural Research Organization of Mazandaran province in 2011. The results of the analysis of a basic scenario showed that conversion to organic farming was more profitable than staying conventional. Sensitivity analysis showed that if depreciation was 25 per cent higher than conventional fixed costs due to machinery made superfluous by conversion, conversion was less profitable than staying conventional. Also the availability of hired labour had a strong effect on the cropping plan and the amount of area converted. Further analysis showed that a slight drop (2 per cent) in organic prices lowers the labour income of the farmer and makes conversion less profitable than conventional farming. For farmers, a minimum labour income can be required to 'survive'. The analysis showed that constraint on minimum labour income makes step-wise conversion the best way for farmers to overcome economic difficulties during conversion.

Laure et. al (2013) tested whether technical efficiency attained under conventional practices was a driver for conversion to organic farming using a sample of French crop farms over the 1999–2007 period. Their findings showed that technical efficiency significantly influenced the conversion decision, but the direction of the effect depended on farm size and type of production. They found that more technically efficient farmers growing fruits and vegetables, farmers growing vineyards and other perennial crops, farmers engaged in horticulture and those growing field crops on relatively small farms (less than 36–73 ha depending on the model) were less likely to convert to organic farming. Only in the case of farmers growing field crops and operating larger farms were found to be having a higher technical efficiency increases and the probability of conversion. Hence, it was found that the probability of conversion did depend on technical efficiency, for dairy farmers in Finland. More precisely, farmers who were better educated, who operate smaller farms and who receive more agri-environmental subsidies were found to be more likely to convert to organic farming. Economic factors such as the potential conversion subsidies and the organic price premium had the expected positive influence on the probability of conversion but they were not significant in general. Non-significance may be explained by the limited cross-sectional variation in these two variables. Finally, their results confirmed that risk and uncertainty should be taken into consideration when assessing farmers' decision to convert to organic farming. They found that a higher variance of output decreased the probability of converting to organic farming, in particular for farmers growing vineyards and other perennial crops. This relationship however holds for farms of relatively low size.

F. Other related studies

John (1994) reviewed the various field experiments conducted on organic farming in Canada. Many sample farms recorded yields that were the same or slightly below conventional farms. Even though some market regulatory problems exist in case of organic products, the prices for them were higher (about 30 per cent) than the conventional products. The study concluded that 72 per cent of farmers strongly convinced that organic farming was as profitable as conventional.

Koikkalainen (1996) examined the relative profitability of organic and conventional farming in Finland. Results were presented according to EU support region and to production type dairy farming, Cattle farming, arable farming, pig farming and vegetable farming (carrot). Farm income was compared as there were major cost differences. Study was carried out over a five year period, cereal

farms and cattle farms were more profitable in organic farming at the given support level. For large farm and vegetable farms, organic production could not be viable.

Dima and Odera (1997) in their study on the possibility of adopting organic farming as a means of promoting sustainable agriculture in Chepkoilel campus farm, Moi University, Kenya, mooted the premise that modern agricultural production was not sustainable in view of the high cost of chemical inputs (notable fertilizers and pesticides) used and their detrimental effects on the environment.

Frank Offermann et. al (2000) had studied economic performance of organic farms in Europe. The main objective was to give an overview of the socio-economic performance of organic farming at the farm and regional levels for all the EU member states and 3 non-EU countries (Norway, Switzerland, the Czech Republic). Specifically the physical and financial impacts were assessed in a review of current and previous studies and specific attention was paid to impact of direct support for organic farming as well as impact of the mainstream Common Agricultural Policy reform measures. Profitability was analysed with yields, prices and cost variables. This analysis of the economic situation of organic farms in Europe had shown that they on an average achieved similar levels of income as compared to conventional farms. However, variance within the samples was high. For specialised, highly intensive farms, it would currently as a rule not be profitable to convert to organic farming. This analysis had proved that organic farming had become more attractive. This was due not only to the support given to this type of farming under current agriculture environmental schemes, but also to general reform measures, which had improved the relative competitiveness of organic farming.

Rahman (2005) measured the impact of modern technology adoption in raising farmers environmental awareness and the impact of farmers environmental awareness on resource use by utilising survey data from 21 villages in three agro-ecological regions of Bangladesh. The econometric analysis was based on the application of the Tobit model explaining farmers environmental awareness in the first stage and a profit function examining environmental awareness and resource use relationships in the second stage. Results revealed that the level and duration of involvement with modern technology raised farmers environmental awareness and that farmers environmental awareness reduced resource use including chemicals. Farmers, who were aware of the adverse environmental impacts of modern agricultural technology, use lower amounts of all inputs in order to avoid further environmental damage. Therefore, efforts to raise farmers environmental awareness

were expected to enhance intangible benefits accruing from a relatively less chemical-intensive environment.

Joel (2005) investigated the socio-economic factors affecting the production of bananas in Rwanda, Africa and a case study was undertaken in the District of Kanama, Africa. After estimating the relationship between the output of bananas and various factors, the findings showed that various socio-economic factors had to be reviewed in order to improve the production of bananas in the country. The results described that acreage (land), physical capital, fertilizer and price, had positive relationship with the output. These were factors on which, the government should emphasize on, in order to increase the production of bananas in Rwanda.

Eyhorn (2006) examined how far conversion to organic management could be a viable option for improving the livelihoods of farmers in developing countries by comparing 60 organic and 60 conventional farms in Europe over a period of two cropping seasons. With a range of qualitative studies they further analysed decision making processes and obstacles in the adoption of organic farming. The results had shown that small holder organic farming systems could produce similar yields as in conventional farming after completing a transitional period of 3 – 4 years. However if innovation in farming shall really improve rural livelihoods, the focus needs to be shifted away from yields to a broader perspective that includes sustainability of the management of production base, economic viability of the farm operations and livelihood security. Appropriate extension approaches that facilitate conversion, and mechanisms for bridging the initial income gap were thus needed.

Cornelis (2006) estimated individual risk aversion coefficients for organic and non-organic arable farmers in the Netherlands. Since arable farmers produce multiple outputs and were exposed to a variety of risks, including production risk, price risk and policy risk, the non-structural approach to risk measurement was applied and extended. This approach had the additional advantage that it was empirically straight forward to implement. Estimating a random coefficient model with panel data on Dutch arable farms using Bayesian techniques, individual Arrow–Pratt coefficients of risk aversion were obtained and the distributions of these coefficients were compared. The results for both groups showed that risk attitudes were heterogeneous. This implied that farmers would manage risks differently. Highly risk averse farmers might diversify or participate in relationships (e.g. co-operatives, contracts) that aimed at reducing risks more than mildly risk averse farmers might do. Moreover,

highly risk averse farmers would be more responsive to policies that aim at reducing risks. Again, this also depends on the perception of risk. That there existed a relationship between risk attitude and risk management, the results also showed that organic farmers were less homogeneous in risk attitude than non-organic farmers.

Tzy-ling (2006) investigated the innovation communication of female farmers in organic agriculture in Taiwan built upon theory of Diffusion of Innovations by Rogers (1995). The purpose of this research aimed to explore use of varied communication channels or approaches of female organic farmers to acquire innovations to develop and sustain their role as a farm manager. A qualitative research employing semi-structured interview was applied in this study. The finding concluded from the present study revealed that female organic farmers indeed utilized a variety of channels or approaches for two types of innovations. Among the channels adopted, inter-personal communication was most used.

Bello (2006) compared the profitability of vegetable production under organic and inorganic production methods among farmers in Ogun state. This study set out to determine the returns to both organic and inorganic vegetable production. Primary data were obtained through a structured questionnaire administered to the farmers practicing the two methods of production in the study area using purposive sampling techniques. Descriptive statistics, cost structure, multiple regression analysis and Chow test analysis were used in the study. The mean age of respondents was 42 years and 44 years for organic and inorganic vegetable production respectively. The farmers cut across occupational groups and educational levels; although 66 per cent for organic production and 56 per cent for inorganic production had no formal education and majority were married for both production methods. The cost structure analysis revealed that organic vegetable production was profitably practiced than inorganic vegetable production in the study area. The regression analysis also revealed that costs of seeds and cost of labour are significant factors affecting the value of the vegetable produced in organic production although amount of manure used was not significantly different from zero. On the other hand, costs of seeds and cost of pesticides significantly affect the output value of inorganic vegetable produced. Seed and labour were found to be under utilized in both production methods. He suggested that establishment of range (grassland) by government to enable the farmers free access to manure at no cost would encourage the organic methods of vegetable production hence enhance their productivity.

Richard et. al (2006) presented a comparative assessment of on-farm and indirect energy consumption, land disturbance, water use, employment, and emissions of greenhouse gases, NO_x, and SO₂ of organic and conventional farming in Australia. A hybrid input-output-based life-cycle technique was employed in order to ensure a complete coverage of indirect requirements originating from all upstream production stages. Using data from a detailed survey of organic farms, the results showed that direct energy use, energy related emissions, and greenhouse gas emissions were higher for the organic farming sample than for a comparable conventional farm sample. Direct water use and employment were significantly lower for the organic farms than for the conventional farms. However, the indirect contributions for all factors were much higher for the conventional farms, leading to their total impacts being substantially higher. This showed that indirect effects must be taken into account in the consideration of the environmental consequences of farming, in particular for energy use and greenhouse gas emissions, where the majority of impacts usually occur off-farm. Subject to yield uncertainties for organic versus conventional farming, from the sample here they concluded that in addition to their local benefits, organic farming approaches can reduce the total water, energy and greenhouse gases involved in food production.

Pazek et. al (2007) calculated two financial indicators for organic farms in Magsaysay such as Net Present Value (NPV) and Internal Rate of Return (IRR). At presumed model input parameters (after 10 years of constant cash flow and 8 per cent discount rate) the results showed that investments into farm food processing on both sample organic farms were financially feasible. The business alternative on sample organic farm (the combination of animal, fruit and field crop food processing) resulted with the maximum NPV value.

Rose et. al (2007) made a study on different factors affecting farmers' adoption of organic rice farming in Magsaysay, Davao del Sur. The behavior of the farmers was evaluated through economic valuation method, specifically willingness to pay (WTP) and willingness to accept (WTA). Attributes like age, number of years in formal schooling, number of seminars attended, number of household members involved in farming, farmers' valuation and tenure exhibited a positive relationship towards the rate of organic adoption. Credit availment and family income were negatively related to the rate of adoption.

Kwasaka-Lwayo (2007) used discriminant analysis to identify the characteristics that distinguish between fully-certified organic, partially-certified organic and non-organic farmers in

Umbumbulu district, South Africa (SA) during October- November 2004. About 200 farmers interviewed were drawn by purposively selecting the 151 members of the Ezemvelo Farmers' Organisation (EFO), and by random sampling 49 non-organic farmers in wards neighbouring EFO. Results from the two estimated discriminant functions suggested that farmers with higher household sizes, incomes, input costs per hectare and number of chickens owned, locations further from innovators and less risk aversion were more likely to be certified as organic. Household location should be considered in delineating target domains for introducing new technologies especially where resources were limited. There was a need for key stakeholders to increase smallholder's capacity to bear risk by decreasing the perceived risk of adoption of certified organic farming.

Chand et. al (2008) estimated instability in three major crops before (1981-93) and after (1993-04) the initiation of economic reforms at the state and district levels in Andhra Pradesh. It has revealed that in a large state like Andhra Pradesh, and which was the case for most states of India, the instability status as perceived through the state level data might be vastly different from that experienced at the disaggregate level. The study has concluded that the state level analysis did not reflect complete picture of shocks in agriculture production, and, further, shocks in production underestimates shocks in farm income. It has suggested the need for addressing risks in farm income by devising area-specific crop insurance or other suitable mechanisms.

Greer et. al (2008) in the Agriculture Research Group on Sustainability (ARGOS) compared the sustainability of organic, integrated and conventional farms in New Zealand by monitoring environmental, social, economic and management parameters. The literature comparing the relative financial performance of organic and conventional agriculture was summarised, and the results of four years' ARGOS monitoring of farm financial performance showed that there were some significant differences in farm costs and revenue across farming systems within a sector, there was greater variability in the "bottom-line" indicators of profitability within farming systems than across them.

Zander et. al (2008) carried out a detailed survey of 50 organic farms in European countries. Organic farming payments were assessed to be 'important' or 'very important' to the economic situation on farms by the majority of the farmers surveyed. The outcome of the economic analysis showed that organic farming payments contributed on an average 4–6 per cent of gross output in the Western European countries and 4–19 per cent in the Eastern European countries studied. The results put the level of specific support for organic farming into perspective, as other support

payments and market returns contributed larger shares of total farm revenue in all the countries analyzed. Organic farming payments accounted for 10–30 per cent of family farm income plus wages in Western European study countries and—after EU accession—up to three-quarters in some of the Eastern European countries, thus highlighting the considerable vulnerability of organic farms to changes in organic farming policy.

Timothy (2009) assisted producers by identifying specific farm and demographic factors that enhance earnings given the choice of marketing outlet in India. The two significant selectivity coefficients confirmed that organic earnings when marketing through a single outlet were biased upward since farmers who were better suited to market through multiple outlets had already moved away from this marketing strategy. An accurate evaluation of the projected earnings from any marketing strategy must account for selectivity effects.

Wiegel (2009) in his research in Missouri compared organic farmers' perceptions and motives by the type of agricultural products produced on their farms. Using a multiple case study methodology, this study compared the elements of the organic adoption decision among Missouri's organic produce, row crop, livestock, and dairy farmers. In order to make comparisons between the farmer types, the study employed the concept of adoption from diffusion of innovations theory as a framework for understanding the elements of the farmers' organic adoption decisions. Five attributes of innovations were used as a foundation for a comparative analysis of farmers' perceptions regarding organic farming—relative advantage, compatibility, complexity, trialability, and observability. Comparing interview responses from organic farmers revealed that motivational and perceptual differences existed between farming sectors. In general, farmers from the organic produce, row crop, and dairy farming categories had more positive views of the attributes of organic farming than livestock farmers do.

Abera (2009) focused on identifying the micro-level factors determining market participation, the level of commercialization as well as evaluating the welfare outcomes of participant small holders in Enderta District of Tigray. Descriptive, statistical and econometric methods were employed to analyze the data collected from a sample of 125 households using structured household questionnaires. The findings from the statistical analysis showed that landholding size and land slope, irrigation use, number of oxen owned, and membership in extension package program have positive and significant association with commercialization while participation in non-farm activities had

significant but negative association with commercialization. Nonetheless, descriptive findings showed that the degree of commercialization in the study area was very low (23 per cent) even in comparison to the national average (33-36 per cent), which was in itself considered to be low. The findings from the probit regression analysis revealed that production level (in value terms), use of improved seeds, use of irrigation and total landholding size were the most important factors affecting the ability of a smallholder to participate in output markets. Moreover, the findings from OLS estimation showed that the level of food and cash crop production (in value terms), gender, technology use (irrigation, improved seeds), use of fertilizer and the number of oxen owned per household were important factors determining the level of commercialization of smallholder farms. Finally, findings from one-way ANOVA analysis indicated that farm households with high degree of commercialization enjoyed better welfare outcomes (represented by consumption of basic non-grain consumables and expenditure on education, shoes and clothes, durables and housing). Therefore, the findings indicate that farmers with high level of commercialization were better-off in welfare outcomes. In addition, the findings indicated that farmers can be better integrated with the market if better support services were provided and efforts to enhance farmers' access to technology and assets were strengthened.

Niaz et. al (2010) assessed the debate over the role of education in farm production in Bangladesh using a large data set on rice producing households from 141 villages. Average and stochastic production frontier functions were estimated to ascertain the effect of education on productivity and efficiency. A full set of proxies for farm education stock variables were incorporated to investigate the 'internal' as well as 'external' returns to education. The external effect was investigated in the context of rural neighbourhoods. Their analysis revealed that in addition to raising rice productivity and boosting potential output, household education significantly reduced production inefficiencies. However, they found no evidence for externality benefit of schooling – neighbour's education did not matter in farm production.

Urkurkar et. al (2010) conducted field experiments at Raipur between 2003-04 and 2007-08 to compare organic, integrated and chemical fertiliser nutrient input packages in scented rice-potato, a high value of cropping system. Seven different nutrient treatments, 5 of them having use of organic inputs and one each having integrated were studied. Organic transition effect in which decline in yield from 1 to 3 years and again increase in yield was noticeable in rice under organic nutrient inputs packages. These treatments followed a steady increase and registered 20 to 50 per cent more yield

at the end of the study compared to first year yield i.e.2003-04. However, effect of different organic input packages on potato tuber yield was not stable over the years. Total productivity in terms of rice equivalent yield of the system (13.36 tonnes/ha.) and total net return (` 92,634/kg) was highest with chemical fertiliser treatment closely followed by integrated inputs use. However, availability of P and K did not show any perceptible change after completion of five cropping cycles under organic as well as integrated nutrient approaches.

Sarker (2010) investigated the influences on decisions by Bangladesh farmers regarding whether to adopt organic farming practices. The study population consisted of all the farmers in three villages (Pirojepur, Kuragasa, and Lokdeo) within the Madhupur sub-district in the Tangail district in Bangladesh. Empirical data were collected from 195 farmers via questionnaires. Among the respondent farmers, the majority (75 per cent) were adopters of organic farming. The results of a logit regression model showed that perceptions of organic farming, household access to extension services, number of family labourers and household income were significantly associated with decisions to adopt organic farming. However, only Non Government Organizations (NGOs) were currently promoting organic farming in Bangladesh and public sector extension has yet to begin promoting organic farming. Thus, to encourage the rapid expansion of organic farming in Bangladesh, it is essential to formulate an organic farming promotion policy, taking into account the above factors that influence farmers' adoption decisions.

Umar et.al (2011) assessed productivity levels of sesame farms under organic and inorganic fertilizers applications in Doma Local Government Area of Nasarawa state. Multi-stage random sampling was used in selecting 96 sesame farmers; made up of 48 organic and 48 inorganic fertilizers users. Data were collected through structured questionnaire and analyzed using total factor productivity analysis, OLS regression analysis and gross margin analysis. Results showed that sesame farmers who applied inorganic fertilizer earned higher returns (41 per cent) over farmers under organic fertilizer. The productivity level of sesame farms under inorganic fertilizer application was higher (27 per cent) over sesame farm under organic fertilizer. Farm size, labour, education and farming experience as well as inorganic fertilizer were factors influencing productivity level of the two enterprises. Poor road network, poor access to credit facility, poor extension service and high cost of inorganic fertilizer were major constraints to sesame production. In order to reduce the gap of income earned and productivity level between the two enterprises, organic fertilizer users should be

encouraged to apply, and educated on the recommended quantity of organic fertilizer require per hectare through effective extension service should be done.

Oyesola (2011) investigated farmers' perception of organic farming in selected local government areas of Ekiti state, Nigeria, with the specific objectives of assessing the demographic characteristics of farmers, identifying the major crops grown by the farmers, assessing farmers' sources of information on organic farming, examining farmers' knowledge of organic farming, as well as assessing farmers' perception about organic farming. A multi-stage sampling technique was used to select 160 farmers in the study area. The data collected were analyzed using frequency counts, percentages and chi-square. Results obtained showed that farmers in the study area were mostly male with a mean age of 53.8 years and married, and had formal education. Crops grown by the farmers include maize, yam, cassava, plantain, vegetables, and tomato. Farmers' sources of information on organic farming were radio, extension agents, television, newspapers, farmers association, fellow farmers, and relatives. Their most preferred sources of information were mobile phones and radio. Farmers in the study area had a high knowledge of organic farming and favourable perception towards organic farming. Results further showed that significant relationships exist between sources of information on organic farming and farmers' perception of organic farming, as well as knowledge of organic farming and farmers' perception of organic farming. These implied that those who have more access to information on organic farming tend to had a favourable perception towards organic farming than those who had less access to information on organic farming. In the same vein, the farmers with high knowledge of organic farming tend to have a favourable perception towards organic farming than those who had little knowledge about organic farming. Policy recommendations emanating from the study were active involvement of youths and women in organic crop production, improvement of information sources on organic farming, and enlightenments on various organic methods of weed, pest and disease control through the regular sources of information on organic farming. Farmers should be motivated through credit facilities and discouragement of inorganic farming in order to ensure sustainable production of food, since the farmers had a favourable perception towards organic farming.

Battacharya (2011) attempted to identify the distinct characteristics between high-yielding and low-yielding farmers growing summer paddy. The study was based on empirical evidence referring to an agriculturally advanced region in West Bengal, India. The study applied Linear Discriminant

Analysis. The study found that high-yielding farmers were best practitioners as well as relatively high adopters of technology and they realized greater average yields. This class of farmers was ahead of low-yielding groups in managerial practices in terms of land preparation, soil-health care and intercultural operations. This study concluded that technology adoption did not depend on the holding size and income level of the growers rather than on know-how practices and skills of the farmers.

Raj K.Adikari (2011) in order to know the economic performance of organic farming in general and that of organic rice production in particular, a survey research was carried out in chitwan, Nepal in 2010. From the study, the average productivity of organic rice production was found 3.15 mt/ha which was consistent higher than national average. Among the factor cost, labour cost was found to contribute highest in total cost of production while poultry manure cost, human labour cost and oil cake cost were found to be significant factors.

Paneerselvam (2011) investigated the perceived relevance, benefits and barriers to a conversion to organic agriculture in three different Indian contexts—in Tamil Nadu, Madhya Pradesh and Uttarakhand states. In each state, 40 farmers from both organic and conventional systems were interviewed. The findings indicated that conventional producers identified production and marketing barriers as the main constraints in adopting organic farming, while the age and education of the farmer were not deemed to be a problem. Lack of knowledge and lack of institutional support were other barriers to conversion. Some farmers were, however, interested in converting to organic farming in the near future in Madhya Pradesh due to the low cost of production, and in Tamil Nadu and Uttarakhand due to the price premium and health benefits. On the other hand, organic farmers were more concerned with health, environment and production factors when institutional support was available. The years under conversion were positively associated with reduced input costs in all three states and with increased income in Tamil Nadu and increased yield in Madhya Pradesh. Both organic and conventional farmers found the two production factors, low yield and pest control, to be of major concern. However, organic farms in Madhya Pradesh and Uttarakhand experienced yield increase because most of the farms were in the post-conversion period, while the farms in Tamil Nadu were in the conversion period and experienced yield reduction. The study suggested that the government scheme for compensating yield loss during the conversion period and a price premium might help farmers to adopt organic agriculture on a large scale in India.

Sarkar et. al (2011) conducted field experiments during winter of 2005-06 and 2006-07 at Hooghly, West Bengal to investigate the effect of different organic and inorganic sources of nutrients on productivity and profitability of potato cultivators. Varieties had significant variations in growth and yield attributes, yield and nutrient-uptake. Higher growth attributes were recorded under 'kufri chipsona-1' except for plant height. The highest B:C ratio was also recorded in recommended dose of NPK treatment.

Naik et. al (2012) conducted an economic analysis of organic and inorganic cultivation of chilli and its marketing. The main aim was to analyse type, pattern and level of use of manures, fertilisers and plant protection measures and cost involved under both types of farming in Belgaum district of north Karnataka using budgeting technique. Random sampling was used to elicit information from 60 organic and 60 inorganic farms. The variables used in the analysis were cost of cultivation, yield, market prices, transport, commission, gross and net returns. They concluded that switching over to organic farming minimises the environmental degradation and also brings higher net returns to compare the yields, market prices and returns of organic chilli with that of inorganic chilli.

Nagaraj et. al (2012) analysed the economics of rice cultivation in Shimoga district of Karnataka. The study was based on primary data obtained from 80 farmers, 40 each of organic and conventional farmers. The data were analysed using tabular method, cost concepts and partial budgeting. The cost of cultivation of organic rice was marginally lower at ` 10,158 than conventional rice cultivation (` 11,564). Locally available organic sources of nutrients such as FYM, other organic manures including sheep and goat manure were used abundantly. Indiscriminate use of fertilisers and plant protection chemicals was noticed in conventional farming leading to marginal increase in cost of cultivation. The yield of organic rice was 18.23 quintals while that of conventional rice was 17.48 quintals. This clearly suggested that organic rice farmers could obtain higher productivity using low cost organic rice technologies.

Aondoakka (2012) analysed the effects of the dynamics of climate on agricultural production. Temperature, rainfall and crops (rice, maize, cassava, groundnut and garden eggs) data were collected for a period of 10 years from the meteorological and agricultural department of the Agricultural development programme(ADP) Gwagwalada. The work assembled and analysed all available data which were needed for evaluating the implication of climate change on agricultural

production in the Federal Capital Territory (FCT). Some measure of central tendencies were used to critically analyse the parameters such as arithmetic mean, standard deviation, coefficient of variance, simple regression, correlation and multiple regression model to correlate the relationship among rainfall, temperature and crop yield. The paper concluded that there existed positive relationship between each climatic element and crop yield but on a very weak significance; there had been constant increase in temperature over the years with 2009 having the highest of 35°C; there was decline in rainfall over the years, and subsequent decline in the productivity of the crops from the correlation carried out in the study.

Jaganathan et. al (2012) conducted a study to find out the knowledge level of organic and inorganic farmers in Tamil Nadu. A total of 240 farmers comprising 120 organic farmers and 120 inorganic farmers drawn randomly from four districts in Tamil Nadu constituted the sample for study. A test was developed for assessing the knowledge of farmers. Organic farmers had better knowledge than inorganic farmers with the mean score difference of 3.73. The variables namely innovativeness, market orientation, extension orientation and mass media exposure had significant relationship with knowledge level of organic farmers.

Arayaphong (2012) quantified and compared costs and benefits of System of Rice Intensification (SRI) and the conventional system of rice cultivation in Thailand to find the best system for a farmer, the environment and a society. The scope of this paper included a farmer's profit, the environmental damages and a society's net benefits categorized in clay soil and sandy loam conditions. The farmer's profit consisted of a production cost and income. The amount of fertilizer application, level of lethal dose and climate change cost were regarded as environmental damage components. The society had concerned over the farmer's profit and the environmental cost in a decision. The study used cost-benefit analysis to investigate mean and variation of profit and cost in monetary term. Monte Carlo simulation was utilized for quantifying risk in each scenario. The study found that SRI saves the production input and increased yield gain significantly. The most impressive results were a reduction in water consumption and number of seeds. Also, the environmental damage caused by this system was lower due to less amount of chemical fertilizer and pesticide applications as well as a low rate of methane gas emission. Sensitivity analysis showed that SRI had better performance under best and worst case scenarios for both types of soil (clay soil and sandy loam).

However, the system contained the highest risk of the farmer's profit. In conclusion, SRI was more beneficial and efficient than conventional system.

Oscar (2012) aimed at establishing the most preferred organic soil management techniques among farmers and the factors influencing the choice of these techniques. This was based on an exploratory study of small-scale organic maize farmers in Bungoma County, Kenya. A simple random sampling approach was used to select a sample of 150 small holder maize farmers and primary data was collected using a semi-structured questionnaire. In the analysis, descriptive statistics and a multinomial Logit model were employed using STATA computer program. The results indicated that extension, farm size household size, gender, age, education, credit, group membership, land tenure, farm distance and slope of land significantly influenced the choice of different techniques. Therefore the study recommended that policies in support of organic soil management should disaggregate farmers according to their socio economic, farmer and farm characteristics in order to achieve their intended objectives. Further there was need to increase extension visits to improve farmer awareness on the advantages of the various techniques.

Umar (2012) evaluated energy use and gross margin estimate between sesame (*Sesamum indicum*) production using organic and inorganic fertilisers in north-central Nigeria. A sample of 120 sesame farmers comprising of 60 organic and 60 inorganic fertilisers user-farmers was used. A structured questionnaire was used in data collection. The results showed that energy efficiency and productivity was higher in organic than inorganic sesame farms by 14 and 13 per cent, respectively. The gross margin earned per hectare by organic fertiliser user- farmers was lower by only 5 per cent than that of inorganic fertiliser farmers; but returns on investments were equal. Hence, organic farms were more energy efficient and productive, and returns on investment was equal, it is recommended that sesame production using organic fertiliser should be encouraged across Nasarawa state in Nigeria, for environmental and income sustainability.

Gido et. al (2013) evaluated maize farmers' perceptions towards organic soil management practices in Bungoma County. A simple random sampling technique was used to select a sample of 650 small holder farmers and primary data was collected using observations and interviews with the help of a semi-structured schedule. In the analysis, a Likert-type five-point continuum scale was used to rank farmers perceptions with one (1) as the most and five (5) as the worst check. The results showed that farmers were invariably concerned about the environment and were interested in

protecting agricultural resources both for the present use and for future generations. Application of green manure and cultivation of legume crops were perceived to improve soil fertility and soil structure. Further, agro-chemicals were perceived to have a negative effect on both human and animal health and their over-application leads to development of pest resistance to pesticides. The study revealed a relationship between perception towards organic soil management practices and some socio-economic and institutional factors such as age, education, household size, extension, training and farm distance. The study recommended policy interventions in enhancing farmers' awareness through training and technical advice on organic farming practices through agricultural extension services and developing information networks among farmers.

Vijaya et. al (2013) carried out a field experiment at Arabhavi, Karnataka with 27 treatments of different combinations organic manures and inorganic fertilisers. Application of FYM, Vermicompost, NPK per hectare recorded significantly maximum plant height, number of leaves per plant and dry root yield. The highest net returns (₹ 37,945/ha) and the highest benefit cost ratio (1:4.07) were recorded with the combined application of FYM, Vermi-compost and NPK per hectare.

Upendra et. al (2013) conducted field experiments for three years during kharif and rabi seasons on Godavari alluvial soils, Andhra Pradesh revealed that, application of recommended NPK along with zinc sulphate resulted highest grain yield, gross return, net return and rupee per hectare invested over exclusive organic farming practices. The result showed more sustainability in yields among all treatments. The organic carbon content was conspicuously increased and status of available soil potassium was remarkably decreased with all the exclusive organic nutrient management practices as well as integrated use of nutrients.

After reviewing the above studies the following research gaps were identified:

- a. Not many studies have been done on organic farming in Tamil Nadu.
- b. A very few studies have included the livestock enterprise which may be essential for optimum economic performance of organic farms.

The present study focuses on a wide range of issues including major organic crops growing in different types of soil and compared it with the inorganic farming in the same area in order to show the sustainability of organic farming in Tamil Nadu which has not been covered in the literature.