CHAPTER-II

REVIEW OF LITERATURE

This chapter provides a brief review of cost of cultivation, yield gap and the relationship between farm size and productivity.

2.1 Rice Cultivation

Easter, Abel and Norton (1977)\(^1\) had analysed the role of quantity of traditional inputs like land, labour and fertilizer and also the quality of certain inputs, mostly irrigation, technology, environmental factors and infrastructure to the total output using production functions. The study covered two regions in India one was the wheat region, and the other region was the eastern rice region. The authors have used data for a period of ten years period i.e., 1959-60 to 1968-69, for all the districts for the value of crop output, crop area, irrigation and fertilizer. The study showed that only the traditional inputs adjusted for value differences which had explained the reason for agricultural productivity differences, within and between the wheat and rice regions in India. In the wheat region area, constant increase in the quantity and quality of irrigation and superior crop varieties were positive sources for growth of output. In case of the rice region, improvements in the irrigation quality, the expansion of rural roads and markets, and superior rice varieties were a key source for the growth of output.

Mencher and Saradamoni (1982)\(^2\) studied the involvement of women in the production and processing of paddy, viz., activities in which large number of women have been traditionally engaged. The study was based on a partial analysis of data from six villages (two each in the states of Kerala, Tamil Nadu and West Bengal). One important feature of the study was that a large number of women were involved in it at all stages. In the study, the authors examined the patterning of agricultural activities of women as well as their contribution to household income. The women in the study


belonged to both landless and marginal agricultural labor households. Different methodologies were used to carry out the present study (1) Charts: Two charts were given to a sample of 16 landless agricultural labourer women in each village. (2) Interviews: In each village a village assistant was hired to work on a part-time basis, to help with day-to-day interviews as well as collecting and distributing the charts, helping the women learn how to mark the charts. And apart from helping with the charts, these assistants were expected to carry out a relatively simple interview every fourth day in a sample of 16 landless households, at a time in the day when the working women were likely to be at home. (3) Other Methods: The other methods which were used for studying the sample of landless and marginal land-owning women include (a) having a senior assistants keep an observational notebook during each visit to each village, (b) informal and random interviews by the two authors when visiting a village, and (c) intensive interviews with each of the sample women (as well as one-quarter of the husbands of these women).

Two important things that emerged from the study were that the introduction of any innovation in paddy cultivation would immediately throw these women out of work and even with the existing arrangement; there was urgent need for creating additional employment for these women.

Dutta (1983)³ made a study on the growth rates of agricultural output in the North Eastern region and made an assessment of the level of its development to its effect in the North-Eastern Region. The North-Eastern Regions taken under study were Assam, Meghalaya, Nagaland, Manipur, Tripura, Arunachal Pradesh and Mizoram, and the period of study was 1969-70 to 1977-78. In the study, she used graphical analysis of the agricultural growth, using the probabilities model, i.e., the reaction function and estimated the growth rates using empirical regression model.

The study showed that the growth rates among the different states of North Eastern region had shown no significant variations, whereas year-wise variation showed linear trend. The results of the empirical regression model estimated showed that there was trend in growth rates, as supported by the application of probabilistic model.

although the fluctuations in the growth rates of the outputs were varying from year to year.

Howbora (1987)⁴ made a comparative study of tribal and non-tribal agricultural practices and its effects on agricultural development in Lakhimpur block, Assam. The main objective was to find the difference in agricultural practices carried out by tribal and non-tribal farmers and impact of these practices on the performance of the agriculture sector in three villages within the block, viz., Mahajian Mishing, Sonari and Bodhakora. About 90 households were taken as sample, out of which 48 households were tribals and 42 were non-tribals. Pre-tested schedules were used to collect data from the head of the households during 1986-87. Statistical analysis of multi-variate type was used throughout the study.

The study revealed that there were two different kinds of agricultural practices in vogue. One type of practice was characterised by broadcasting method of sowing seeds of Ahu and Bao varieties, which was popular among the tribals. And the other type of practice was characterised by transplanting method of growing Sali variety of paddy, which was popular among the non-tribals. The non-tribals often used organic manures.

The study implied the need to develop the irrigation facilities in the area, the need to provide more rest and readiness to the farmers and the need to motivate the use of organic manures.

Buragohain (1988)⁵ attempted to assess the growth of agricultural sector in North-East India during 1972-83. Attempt was made to determine the relative contributions of growths of area and the yield to the growth of output. Data for the study were taken from Basic Statistics of North-Eastern Region, North-Eastern Council, Shillong.

The major findings of the study were that the gap between the growth of output of food grains in the regional economy of North East India and the national economy has

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tended to increase. The growth of yield had sustained the growth of national output, but
the growth of regional output has been sustained mainly by the average growth. Within
the region, all the states, except Mizoram and Assam, had recorded satisfactory growth of
output, though there were considerable inter-regional inequalities in their growth
performance.

Nirmala (1992) made a comprehensive study of the cost and return structure of
the two rice varieties IR20 and CO37, determinants of their yields, yield gap and yield
constraints, farm size and productivity, distribution of farm income, supply and demand
elasticities and labour absorption and economic efficiency of the farmers in Gokilapuram
village, Tamil Nadu. A random sample of 100 IR-20 farmers was drawn and 50 CO-37
farmers were selected for the study. The primary data were collected during the Rabi
seasons of the agricultural year 1985-86, using pre-tested questionnaire. Multiple
regression model was used to identify the major determinants of yield. Yield gap was
estimated as the difference between the maximum yield and average yield, and Garrett’s
ranking technique was used to rank the yield constraints. The relationship between farm
size and farm efficiency was studied using simple linear regressions, and Gini coefficient
was used to examine the inequalities in income distribution. The study showed that IR-20
growers obtained significantly larger yield per acre than the CO-37 farmers. Rice
cultivation was found to be labour intensive in the study area. The regression analysis of
CO-37 yield showed that all the five factors had positive influence on yield per acre and
human labour was observed to be the most influential variable. Whereas in the case of
IR-20, net return proved to be the most influential determinant of yield. The nature of
relationship between farm size and productivity for both the rice varieties showed a
negative and significant relationship. Income inequality was found to be more under
CO37 rice variety.

Fageria and Baligar (2003) reviewed earlier literatures available on upland rice,
mostly cultivated in Asia, Africa and Latin America. The productivity of upland rice was

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found to be very low and was consistently subjected to many environmental issues. However, when the upland rice was cultivated in mono-culture for more than two to three years on the same land, allelopathy or autotoxicity was commonly found, which leads to complicated plant and chemically interacted plant.

The study suggested that adopting proper management steps in crop relations could help to solve the problem of allele-chemicals phyto-toxicity. In fact the authors concluded that rice productivity could also be enhanced by growing rice in rotation process with other crop variety. This study highlighted that the current information of allelopathy in upland rice is not enough and incomplete, therefore better studies were required to be familiar with and to decrease the harmful effects of allelopathy in the upland rice production.

Janaiah and Hossain (2003)\textsuperscript{8} over-viewed the major findings of case studies in six sites in tropical Asia, and drew a few implications for further development of hybrid rice research. The study was carried out to analyse the factors affecting the adoption of hybrid rice cultivation, and to assess its relative profitability, besides to find out constraints to hybrid rice adoption based on farmers’ perceptions. The research was done in four parts of south Asia and in two parts of South-East Asia during the years 2000-02. Sample size in each case study was fairly large, but due to low and scattered adoption of hybrid rice, a random sampling technique could not be followed strictly except for Vietnam. A purposive sampling technique was followed in other cases by selecting areas of focus for the extension of the technology. Farm level data on socio-economic characteristics of the respondents, allocation of land to cultivation of hybrid and existing in-bred varieties, details of crop management practices and costs and returns were collected using a structural and pre-tested questionnaire in all study sites. Data were analysed by applying an integrated analytical approach. In addition to various central tendency measures, yield response functions, adoption functions were estimated to achieve the study objectives.

The results of high yielding variety rice showed that there was higher yielding potential within the farmers’ fields in all study areas, except in Tamil Nadu. Lower market price for high yielding variety rice was observed in India which implied that there was only marginal advancement in the technology in India. Yield gains were associated with production cost in all case studies. The estimates of adoption functions in different study sites indicated that level of education had a significant positive effect on the rate of hybrid rice adoption. Small and marginal farmers in North and Central Vietnam, and Bangladesh had showed more interest than the large commercial farmers in India and Philippines in cultivating hybrid rice. Vietnam was the only country in tropical Asia, where high yielding rice variety had been largely grown in its Northern and Central regions.

Talukdar and Beka (2005)⁹, studied the development of summer rice and economics of its cultivation in the flood-prone districts of Assam. Districts like Kamrup, Nagaon, Sibasagar and Lakhimpur of Assam state was selected for the research and the secondary data were taken from different available sources during to the period of 1951 to 1998. However, the authors collected the primary data using the stratified random sampling technique in the year 1998. 59 marginal and 43 small farmers were chosen for the study. The Compound Growth Rates (CGR) was calculated using the exponential growth model for area, production and productivity of summer rice. Further the growth rates were tested at one and five per cent levels of probability. The co-efficient of variation was applied to check the stability of productivity which was again later on studied using Cuddy-Delle-Valle (C-D-V) index in different periods. The authors has used the simple tabular analysis to examine the effect of levels of technology on productivity of the crop. Further, by calculating the cost of production at A and C levels with cost-return ratios, the economics of cultivation of summer rice was analysed for both high yielding varieties and local varieties.

It was further concluded that the cultivation of summer rice has developed faster than that of autumn and winter rice. The growth rates of the summer rice with respect to

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area, production and productivity has been more rapidly in the modern days. The result showed that of all the districts, Nagaon performed better, whereas, Lakhimpur showed the worst result. It was observed that marginal farms had not earned much as compared to other farm sizes in case of the summer rice cultivation. Thus the study concluded that, low economic position, poor purchasing control of the marginal and small farmers, and land degradation which was the result of continuous use of chemical fertilizer were the main obstacles in its advanced cultivation in the study areas.

Samal and Pandey (2005)\textsuperscript{10}, had analysed the climatic risks which was faced by the farmers in Orissa and how they overcame the loss in rice production. The study was conducted the village Kaudikol of the Cuttack district (Mahanga block) in Orissa. For the study, based on the farm-size categories, the farmers were classified into four groups marginal famers, small farmers, medium farmers and large farmers. 60 farmers were then selected in random basis, comprising 25 marginal, 13 small, 19 medium and three large farmers. This collection of data was done during the period 1996-97 to 1999-2000. After deducting the expenditure costs from the gross return, the net incomes from different crops were also computed.

Finally, the study showed that one-fifth of the total income of the farmers, were being earned through the cultivation of rice. Submergence, drought and cyclone had altogether affected the productivity of kharif rice during the study period. Income diversification due to other crops, and other non-farm activities had helped the farmers to stabilize their farm income. Though, small farmers had overcome the loss of income from the kharif rice through wages from other business, and cultivating other crops. The large farm size group overcome the loss from rice income from others incomes like business, service, and other crops cultivation.

Suresh and Reddy (2006)\textsuperscript{11}, studied the efficiencies of price and technology in relation to the productivity of paddy cultivation in the Peechi Command Area. Primary data was collected using the stratified random sampling, 71 paddy cultivators were selected for the study. The Cobb-Douglas production function was used to find out the productivity of inputs used in paddy cultivation. Further, dummy variables were also included in the production function. And the Ordinary Least Square (OLS) approach was used to estimate the Cobb-Douglas function. Finally, by estimating the ratio between Marginal Value Product (MVP) and Marginal Factor Cost (MFC) the Allocative Efficiency (AE) was calculated.

The authors concluded that the benefit cost ratio of the paddy cultivation in the Peechi Command Area of Thrissur district in the Kerala was observed to be 1.34. Of all the inputs, human labour and farmyard manure was the highest in the total cost of cultivation. The allocative efficiency analysis showed that by spending an extra one rupee on fertilizer, plant protection chemicals and human labour the total returns would increase by Rs 2.83, Rs 1.57 and Rs 1.17, respectively. The study showed that the average technical efficiency of the farmers was observed to be 66.18 percent. Finally, the education level of the farmers and the irrigation cost had a positive and significant impact on the technical efficiency of rice farmers whereas the presence of water-stress had a negative impact.

Gajja, Chand and Singh (2006)\textsuperscript{12}, studied the effects of natural resources like soil and other factors on the productivity and profitability of crop within the different land irrigability classes in the semi-arid areas of Gujarat state. For the study, Ukai-Kakrapar, Kakrapar Left Bank and Mahi Right Bank canal command irrigation projects in Gujarat were chosen for the study. From around 400, 180 and 500 farmers which were distributed over 40, 18 and 50 villages of UKRB, KLB and MRB canal command areas, the data


were collected during the years 1990-91 and 1991-92 using the multistage stratified random sampling technique.

The study was carried out using a multiple regression analysis i.e., Cobb-Douglas production function in order to measure the extent of impact of various factor inputs on land efficiency. By taking, Crop yield (q/ha) as dependent variable and the quality of land, quality of the soil, fertilizer and manure cost, labour hired in man-days, Family labour in man-days and other extra costs like seeds, chemicals, ploughing, and irrigation charges, etc. as independent variables, the Cobb-Douglas production function was carried out. With the purpose to identify multi-co linearity, zero order inter-correlation matrices were carried out and further, the inter-correlations were compared with the co-efficient of multiple correlations.

The results showed that farmers of involved in high water-requiring crops cultivation had ignored the recommended cropping pattern. Sugarcane and rice were being produced in the land irrigability classes III, IV and V which resulted to water-logging, secondary salinization, and decline in crop yields. Thus, it has been concluded that costly production activity and fall in the economic returns has compelled the farmers cultivating the land of lower irrigability classes to use less inputs. And the authors have suggested that based on land irrigability classes crops must be chosen, only then a higher productivity could be achieved at minimum cost in the study area. And in order to prevent secondary salinization, higher crop production along with low production cost and recyclable environment canal irrigation under land irrigability classes I and II should be carried out.

Varinderpal, et. al. (2007)\(^{13}\) conducted a study to evaluate the grain yield and Nitrogen (N) use differences in the field-specific Nitrogen fertilizer management which was based on leaf colour chart (LCC). Around 350 on-farm experiments were carried out during the years 2002-2005 in 10 different districts of Punjab. Further, through random selection, farmers were selected by the scientific staff and the study was conducted with

the assistance of farmers under the guidance of the scientific staff. The top-most fully expanded leaf was placed on the top of the leaf colour chart and the colour of the middle part of the leaf was graded according to the corresponding colour strip on the LCC. In order to determine the impact of method of Nitrogen application on yield and Nitrogen requirement of rice crop the randomized block design was used and the Partial Factor Productivity (PFP$_N$) of applied nitrogen was calculated to analyse the efficiency nitrogen use.

The results showed that application of fertilizer Nitrogen to irrigated transplanted rice, following shade four on the LCC as the critical leaf colour produces as much grain yield of rice as produced by applying 120 kg N ha$^{-1}$ or more fertilizers Nitrogen in three equal splits at transplanting and three to four weeks after transplanting. The practice by farmers to take care of field-to-field and temporal variations in soil, nitrogen supply caused a substantially higher amount of fertilizer Nitrogen to be applied. In contrast, real-time need based fertilizer nitrogen management synchronized well with the Nitrogen requirements of the rice crop thereby resulting in substantially higher partial factor productivity. LCC-based Nitrogen management could adequately take care of field-to-field and temporal variations in Nitrogen-supply to rice and thus hold promise in increasing fertilizer Nitrogen use efficiency in rice.


The results showed that the yield achieved was not enough as the farmers obtained very low level of yield due to poor management. The authors suggested that there could be a greater scope for higher yield and net return through the adoption of suggested production machinery in the study area. They have also pointed out difficulties faced by the farmers which were high fertilizer cost, seed quality, the pest problems and absence of credit facilities. The authors further suggested that the agricultural extension

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service would develop farmer's awareness in modern machinery. And thus, all the approving production inputs should be ensured for a better crop production.

Senthilkumar and others (2008)\textsuperscript{15}, had described, the influence on the success of introducing this new approach to rice production is based on the experiments on the adapted management practices for rice production, the experiences of farmers in testing and adopting these practices and factors. At Tamil Nadu Agricultural University, Coimbatore, they conducted an on-station experiment. Experiments one and two were done during the wet season from September 2001 to January 2002 with rice hybrid CORH2 and during the dry season from February to June 2002 with rice hybrid ADTRH1. Four management factors were used as treatments in a split-plot design with four replicate blocks. The most important plot treatments done were planting method and irrigation use with sub-plot treatments of weed and nutrient management. The authors suggested that the results of the on-station experiments were considered adequately helpful for the Government of Tamil Nadu to support Adaptive Research Trials (ART) together with 200 rice farmers during 2003–2004, with 100 farmers in each of the two major rice-growing areas of the state; the Thamirabarani river basin and the Cauvery river basin. To understand the inputs that influenced adoption or dis-adoption of the technologies by farmers, surveys were conducted on two farms. The first survey was conducted during August to October 2004 in the Thamirabarani river basin to achieve a general description of the current situation of rice cultivation in both technical and social terms. In full, 25 farmers were interviewed by a comprehensive questionnaire on the newly-introduced modified rice cultivation and the problems related with the limited and irregular accessibility of irrigation water. The second, further extensive farm survey had been conducted from June–September 2006. Out of the 100 farmers in the ARTs in each river basin, one in every two farmers in the Thamirabarani and one in four in the Cauvery were interviewed. The survey intended to understand the farmers’ point of view on factors internal and external to their farms which influenced their implementation of the new technologies, and to recognize the issues that need to be considered in the future for

designing new alternative for improving the livelihood of the resource poor farming community.

The results of experimentation for both on-station and on-farm pointed out that water saving of 40–50 percent was achievable without any negative effect on rice yields; farmers’ interest in the implementation of the practices was diverse. The farmer-managed on-farm experiments pointed out that modified rice cultivation method gave improved yields, and these benefits were clear to the farmers. However practicing the modified rice cultivation farmers had a number of practical problems including the need for additional time and labor for the modified planting method, complications with dapog nursery preparation and the shift from women’s labor to men’s labor for mechanical weeding. Since water was given free of cost to the farmers, they had a tendency to flood their rice fields when the canal water was released as there was no guarantee for water availability for the next irrigation.

Naing and others (2008)16, examined the biotic and a-biotic constraints to production from a thorough survey of Myanmar’s main rice growing regions. Qualitative data were gathered during 107 semi-structured interviews with farmers over a duration of two years in the two main agro-ecological zones of rice production, i.e., in Lower and Upper Myanmar. During the rainy season of 2001, 52 respondents in ten townships were located in Lower Myanmar and in three townships in Upper Myanmar were interviewed. In 2002, 55 respondents from nine townships in Lower Myanmar and three townships in Upper Myanmar were interviewed. The data were analyzed using Gen-Stat 5th edition (2001). Averages were compared by t-tests, Multiple and linear regression analyses were also used as required. And for the fertilizer input comparison, type dependent conversion factors for nutrient concentrations in mineral fertilizers were employed. This method showed to be more complicated for farmyard manure (FYM), which possibly had a dissimilar composition at each site.

The study showed that agronomic setback such as low rates of applied manure and chemical fertilizers, low seed quality and poor weed and water management were seriously big limitations to rice production in Myanmar. Particularly, the very low amounts of fertilizer that were presently applied to rice were most likely the major cause for the low yields of rice in Myanmar. The use of fertilizers, in particular Nitrogen, was necessary for increasing rice yield. In addition, sources of Phosphorus and Potassium were essential. As market opportunities determined which crops farmers should grow, and the cropping sequence per se had little to no effect on rice productivity.

Radha and others (2009)\textsuperscript{17}, studied the economic investigation of water-saving rice production technologies to compare the economics of water-saving rice production technologies vis-à-vis farmers’ practice, and to analyse the water-use efficiency of water-saving rice production technologies vis-à-vis farmers’ practice. The study was carried out in one of the selected areas of APWAM Project, viz. Modukuru village of Tsunduru mandal in the Guntur district. In total, 214 farmers with a cultivated area of 264 ha were covered under the selected Modukuru branch No. 2 canal for the study. The three identified water-saving rice production technologies, viz. SRI (System of Rice Intensification), Semi-dry and Rotational irrigation were demonstrated in farmers’ fields, over a period of four years, from 2004-05 to 2007-08, and were compared with the farmers’ practice for analysing the economics of cost of cultivation and returns. The water-use efficiency was calculated by using CRIWAR model for all the three selected technologies and was compared with the farmers’ practice.

The results showed that the area under semi-dry cultivation had improved over the past three years, reflecting the advantages related with this technology. The costs and returns of all the three water-saving rice production technologies along with the farmers’ practice showed that the highest yield of was recorded in SRI, followed by semi-dry and rotational irrigations compared to farmers’ practice. The net benefit-cost ratio was highest in semi-dry, followed by rotational, farmers’ practice and SRI. The water-use was

recorded maximum in farmers’ practice, followed by rotational, semi-dry and SRI methods.

Devi and Ponnarasi (2009)\textsuperscript{18} conducted a study to find the economics and the farmer’s adoption behaviour of the system of rice intensification (SRI) in the year 2009. A multi-stage stratified random sampling procedure was adopted for the study. In the first stage, Cuddalore district of Tamil Nadu was purposively selected. In the second stage, taluks were selected from the Cuddalore district, based on the taluk-wise data on the number of farmers adopting SRI method and blocks were selected in the third stage. The list of farmers adopting SRI was obtained from the Department of Agriculture. The data were collected from both primary and secondary sources. The primary data collected from the sample rice growers included the general particulars like age, farming experience, educational level, landholding pattern, occupational pattern, employment level, income level, reasons for cultivating SRI and the reasons for not cultivating SRI. Descriptive statistical analyses such as mean and percentage were carried out for making a comparison of general characteristics of sample farms. Farmers’ adoption of SRI was studied using logit model. The study utilised a logistic regression model to empirically quantify the relative influence of various factors in the decision of the respondents to adopt SRI method or conventional methods of rice cultivation. The study postulated that the probability of a farmer adopting SRI method depended on the attributes like age, literacy level, farm size, income, number of earners in the family and number of contacts with extension agencies (per month). The Garrett ranking technique was also used to study the opinions of the farmers regarding the adoption of SRI and the cause for not adopting the SRI technology by other farmers.

The study had showed that the per-hectare cost of cultivation was about 10 per cent lower in SRI than the conventional method. The logit framework had pointed out that age, farm size, income of the farm, number of earners in the family and number of contacts with extension agencies were positive and highly influenced the adoption behaviour of the farmers. Lack of skilled labor, awareness, training on new technology

and experience was opined as the main problems in the adoption of this technology by the farmers. As a result, farmers have been vastly benefited by SRI technology and have helped them in their socio-economic upliftment. The adoption of SRI technique has helped increase the rice production without increasing the area under its cultivation and has proved to serve as an alternative method for rice cultivation.

Barah (2009)\textsuperscript{19}, had quantified the benefits of SRI over non-SRI practices of rice cultivation in Tamil Nadu. A thorough farm survey was conducted during 2006-07 in four important districts of Tamil Nadu viz., Tanjore, Coimbatore, Kanchipuram and Ramanathapuram. The sample for the study consisted of 15 SRI and 15 non-SRI farmers in each of the districts, except Ramanathapuram, where the number of SRI farmers was only 13. The technical efficiency, allocative efficiency and economic efficiency of SRI was computed using the Frontier production function approach.

The results showed that SRI has proved its ability to increase rice production by 26 per cent or more depending on the extent of adherence to its basic principles. More importantly, SRI has saved up to 40 percent water due to alternate drying and wetting system, which was considered a unique advantage of SRI. The farmers were convinced of the benefits of SRI and hence its adoption was spreading in larger spatial dimensions. A few distinctive patterns and models had emerged in recent years, which provided required road map for wider adoption.

Nirmala and Muthuraman (2009)\textsuperscript{20}, conducted an analysis on economics and major constraints in rice cultivation in Kaithal district of Haryana. The study was carried out in Kaithal district of Haryana. From which two blocks namely Rajound and Pundari were randomly selected, further, two villages from each block were selected. And from each village twenty farmers were randomly selected. Thus in total, 80 farmers were selected. The data on cost-returns aspects of rice cultivation were collected through pre-

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structured questionnaires. The data collected on Kharif 2007 was subjected to statistical analysis.

The results, in conclusion showed that machine labour and human labour constituted major costs in the total variable costs. Since the benefit cost ratio was 1.27, rice cultivation was economical in the study area. Pests and disease incidence, lack of remunerative price, labour shortage were the major constraints in rice production in Kaithal district. According to the author, management of pests and diseases, and addressing the problem of soil salinity would facilitate in enhancing the yield levels in Kaithal district.

Sarungbam and Prasad (2011)21 conducted a study to identify the factors responsible for mono cropping of rice in Manipur. Multi-stage random sampling technique was used to select the districts, blocks, villages and finally the farmers. Two plain districts Bishnupur and Imphal East were selected randomly. From five blocks of each of these two districts, nine villages were selected by proportionate random sampling. The farmers were divided into four distinct groups based on their operational land holding, viz., marginal (<1 ha), small (1.01 – 2 ha), medium (2.01 – 5 ha) and large (>5 ha). Using proportionate random sampling, five percent of the households were selected from each stratum, yielding a total of 369 farm sample households. The data were collected through comprehensive pre tested schedules and personal interviews by recall memory method in 2007-08. Logistic regression models were evaluated from a set of nine variables, viz., Availing institutional credit, Availing non-institutional credit, Availability of inputs, Age of a farmer in years, Experience of a farmer in years, Education of a farmer, Nutrition, Comparative advantage of rice over other crops and Non-awareness of technology for identifying the factors affecting adoption of mono cropping in rice in Manipur.

The study showed that among the factors affecting mono-cropping of rice in Manipur, availing of institutional credit had been found to be negatively significant in the marginal and the medium farms, while availing of non-institutional credit was negatively

significant in the marginal, small and medium farms. Education had been found negatively significant across three farm-sizes, viz. marginal, medium and large farms. Nutrition has affected all the farms positively and significantly. Comparative advantage and non-awareness about technology has also affected all the farms positively, though comparative advantage had been found significant only in marginal and small farms, while non-awareness about technology had been observed significant only in medium and large farms. Thus the study had highlighted the need for focus on crop diversification and increasing cropping intensity. Strengthening of co-operative societies, increasing availability and accessibility of credit facilities, increasing awareness about new technologies etc would help in increasing the cropping intensity, thereby using the available rich resources to the optimum level in the state.

Pooniya and Shivay (2011) studied the effects of summer green-manuring crops and Zinc fertilization on the productivity and economics of Basmati rice in Asia. Field experiments were carried out during the summer–rainy season (Kharif, April–November) at a research farm of the Indian Agricultural Research Institute, New Delhi during 2008 and 2009. The experiment was carried out in a split-plot design. Yield was expressed in t ha⁻¹, and gross and net returns were calculated based on the grain and straw yield and the prevailing market prices of Basmati rice during the respective crop seasons. Benefit-to-cost ratio (B: C) was calculated by dividing the net returns from total cost of cultivation. All the data obtained from short-duration summer green-manuring crops and Basmati rice for consecutive two years was analyzed statistically using the F-test.

Based on the two years of field study, it was concluded that the residue incorporation of Sesbania aculeata (SGMI) summer green-manuring crop and application of 2.0 percent Zinc enriched urea (ZEU) increased growth and yield attributes and yields of Basmati rice compared with the remaining green-manuring crop and Zinc fertilization treatments. Among the summer green-manuring crop residue incorporation and Zinc fertilization treatments, SGMI and 2 percent ZEU gave the highest gross and net returns and B: C ratio of Basmati rice.

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Geethalakshmi, Velliangiri and others (2011)\textsuperscript{23}, conducted field experiments during summer (March-July) and kharif (June-September) in 2008, at the wetland farm, Tamil Nadu Agricultural University, Coimbatore, India, to evaluate the performance of different systems of rice cultivation. The experiment was laid out in a randomized block design with four replications. Treatments consisted of different rice cultivation methods, namely, transplanted rice (conventional), direct sown rice (wet seeded), alternate wetting and drying method, system of rice intensification and aerobic rice cultivation. Rice hybrid CORH -3 was studied as the test crop. The collected data on various parameters was analyzed statistically. The treatment combinations were statistically analyzed separately and the results were furnished at five percent critical difference level.

The results revealed that maximum number of tillers m\textsuperscript{-2}, higher shoot and root length at maturity were recorded under, system of rice intensification, followed by transplanted rice, while aerobic rice produced lower growth parameters in both the seasons. Chlorophyll content at flowering was higher under, system of rice intensification and transplanted rice in the two seasons studied, compared to aerobic rice and alternate wetting and drying method. In both, summer and kharif seasons, system of rice intensification produced higher grain yield, followed by transplanted rice, respectively. In respect of water productivity, the system of rice intensification method of rice cultivation registered the highest water productivity, followed by alternate wetting and drying method and aerobic rice cultivation. The conventional rice cultivation and direct sown rice produced lower grain yield per unit quantity of water used.

Kar and others (2011)\textsuperscript{24}, characterized the physical environments of a representative deep water rice (DWR) varieties (Hangsewari, Saraswati, Ambika and Sabita) was compared with that of local varieties (BAneki and Dhalakaertik) at three water depths, shallow flooded (0.6-0.8m), medium flooded (0.8-1.2m) and deep flooded (>1.2m). In the study, the physical environments of a representative deep-water ecology


\textsuperscript{24}Gouranga Kar, Narayan Sahoo and Ashwani Kumar, “Deep-water Rice Production as Influenced by Time and Depth of Flooding on the East Coast of India”, Archives of Agronomy and Soil Science, Vol. 58, No. 6, June 2011, pp. 573-592, Accessed on 10/05/2013.
were studied and the performance of improved Deep Water Rice (DWR) varieties was compared with that of local varieties at three water depths and deep flooded. In the investigation, the rainfall flooding depth relationship was also studied and the probability of successful crop production in relation to time and depth of water logging was investigated based on 34 years of historical flood data from the region. The experimental plots were located in a farmer’s field of Alish a village, Puri district, Orissa, India. Total soluble sugar (TSS) and starch content in the rice grain were also determined using the Anthrone method. These parameters were determined in brown rice on dry weight basis. From the rainfall data of the past 34 years, monthly rainfall at 30, 50 and 70 percent probability levels were computed using normal, log normal, log Pearson and extreme value probability distribution methods. The estimated rainfall was compared with that of observed values, computed by using inverse Weibulls’ formula,

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P = \frac{m}{N} + 1 \times 100;
\]

where, \(P\) = Probability of rainfall,

\(m = \) rank number and

\(N = \) total number of years.

The results (E) obtained using four probability distribution functions were compared with that of observed values (O) by chi-square test of goodness of fit to find out the best fit probability distribution for predicting monthly rainfall in the region.

The study revealed that with the introduction of improved DWR varieties, productivity during the rainy season was enhanced and farmers received good yield (2.05–2.95 t ha\(^{-1}\)) and net returns (4500 Rs ha\(^{-1}\)). The study also revealed that success and failure of the rainy season rice crop depends upon the onset time of the monsoon, rainfall distribution, and time and depth of water-logging. Knowledge of flood characteristics such as the nature, duration and frequency of flooding, data on turbidity, water quality and water regimes in shallow, intermediate and deepwater were helpful for adopting DWR. Important crop traits like elongation capacity for particular situations, tolerance for complete submergence for a minimum of seven days, photo-period sensitivity, good
tillering ability, kneeing ability, and a strong rooting system with non-shattering grains were very desirable for the successful adoption of rice varieties in deep-water ecology.

Jamala and others (2011)\textsuperscript{25}, analyzed the factors influencing farmers’ adoption of irrigated rice cultivation by small-scale dry season farmers in Fadama soils. The study area was situated at the North-Western part of Jimeta, Yola in Adamawa State, North Eastern Nigeria. The respondents (farmers) interviewed were selected using a simple random sampling and purposive sampling techniques, proportional to the size of the farm. A sample of 120 farmers formed the sample size. Descriptive statistical analyses such as frequency and percentage were carried out on problems encountered by the farmers. The gross margin analysis was used to estimate the costs and returns associated with rice production in the study area. Farmers’ adoption of irrigated rice production was studied using logit model. This study utilized logistic regression model to empirically quantify the relative influence of various factors in the decision of the respondents to adopt this method. The relationship of this dependent variable was examined with the independent taking Logit or log of odds ratio as dependent variable, and taking Adoption of sole rice production, Adoption of any other crop production, Coefficients to be estimated, distribution term, Farming Experience (years), Household size (number of persons in a household), Education (number of years of formal schooling), Gender (binary variable, 1 = male, O = Female), Market availability (binary variable, 1 = if Yes, o if No), and Labour availability (binary variable, 1 = if Yes, O = if No) as independent variables.

From the findings of the study it was concluded that the choice of irrigated rice production depended mainly on the availability of market and labour. Also, worthlessness of a venture was a major determining factor. Efforts geared towards improving the availability of labour and market would enhance the adoption of irrigated rice enterprise.

Mukherjee and Gupta (2011), studied the presence of heavy metal toxicity in wastewater and soil negatively impacts on the profitability of rice cultivated in the East Calcutta Wetlands region. The sampling areas were Babupara; Kantatala; Vatipota; Narayanpur; Ghoshpara. The samples were gathered in March-April, 2010, during the summer crop. For profit data, 360 households were surveyed in total with 40 from each of the sampling points. These households provided us with profitability information for 565 plots in all located in the sampling points taken together. Since the study area was too small for climate-logical variations from one observation unit to the other, they did not consider the climate as an attribute in the argument of the profit function. Therefore, the study primarily estimates the profit function was specified as: \( \text{Profit per kg of rice} = f \) (Plot size, price of output and its square, Dummy one for use of local varieties of rice seed, prices of seed, tractor, main and supplementary fertiliser, main and supplementary pesticide, labor and the squares of each of these, Dummy two for use of canal water, levels of Chromium, Lead and Mercury in canal water and soil and the squares of each of these)

The results showed that plots using wastewater containing organic nutrients earned higher profits than those using groundwater. However, it was also found that the profitability of plots using wastewater was negatively affected by the presence of heavy metals such as Chromium, Lead and Mercury in the water and soil. Of the two opposing effects of wastewater irrigation, the positive effects of organic nutrients outweigh the negative effects of heavy metal toxicity. These results supported both efforts to conserve the Wetlands, which would generate a number of ecological benefits, as well as to regulate the discharge of heavy metals into the water from households and industries that were located upstream in the city of Kolkata.

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Haldar, and others (2012)\textsuperscript{27}, made an attempt to study the comparative economics of System of Rice Intensification (SRI) method rice cultivation and conventional method in West Bengal state. The highest rice producing Bardhaman district was selected purposively. Random sampling technique was adopted for selecting blocks, villages and farmers. In Bardhaman district four blocks (Ausgram-1, Ausgram-2, Bhatar, Galsi-I) were selected randomly. In each block 15 farmers were randomly selected constituting 60 farmers each under SRI and conventional method of rice cultivation. Thus 120 sample farmers were interviewed personally with structured schedules. The farm management cost concept (Cost A1, Cost A2, Cost B, and Cost C) was used for evaluating crop profitability. Production function analysis was employed to analyse efficiency of rice production. To know the factors influencing adoption of SRI method of rice cultivation, binary logistic regression was used. The independent variables considered were age of the sample respondents, Educational level of the farmer in years, Per capita income of the sample respondents in Lakh Rs, Membership: 1, if the respondent has membership in a co-operative or any other financial organization, 0 otherwise, Contacts: 1, if the respondent has frequent contact with extension agent, 0 otherwise, and Distance of the farm from the canal in kms.

It was concluded that besides the less resource use, the profitability (return per rupee) in SRI Rice cultivation was higher vis-a-vis conventional method. Hence the farmers had to be educated and empowered through training and demonstrations. The efficiency level (both technical and allocative) in SRI was higher compared to conventional methods. Logit regression analysis indicated that, educational level and distance from the canal increases the probability of adopting the SRI method. The relevance ranking analysis indicated difficulties in management practices like water management and intercultural operation. Lack of water availability especially in rabi season and unavailability of skilled labour were major constraints to SRI method adoption. Hence the authors suggested that appropriate interventions like empowering farmers through training and demonstrations with proper guidance from extension personals had to be made for larger adoption in the study area.

John and Fielding (2014)\textsuperscript{28}, examined where research relevant to production constraints was focused, and how that fitted with where yield losses were known to take place. The study looked specifically at research on rice in South Asia, since the region was home to one of the world’s largest food-insecure populations, and rice was the most important crop there. The study also identified whether research had made connections between different areas of production constraints and environmental concerns, that there were recognized as new challenges for smallholders. The study examined the extent to which agricultural research had prioritized the greatest factors that constrain smallholder productivity in those farming systems. It also explored the degree to which research had connected production constraints and environmental challenges faced by rice smallholders.

The result showed that while national and international research bodies were well aware of the challenges smallholders faced, there seemed to be a lack of coordination in setting research priorities, since there were many areas, particularly in the social sciences field, which were not receiving the research attention that they warranted, when compared to the opportunity improvements in this sector could provided. This suggested that steps were needed to be taken in providing the research community with incentives and support in understanding these ‘needs’ to increase the impact of their research. Increasing the level of accountability of research institutions to smallholders’ and rural populations’ needs and promoting participatory farmer-focused research could help in improving research coordination and improving livelihoods by reducing poverty.

2.2 Organic and Inorganic Crop Cultivation

Hanson, Lichtenberg and Peters (1997)\textsuperscript{29}, checked a farming system trial at the Rodale Institute Research Centre in Kutztown, Pennsylvania. They constructed long-term enterprise budgets for the organic and conventional cash grain rotations and compared returns earned during the first years of the study and found that over time the organic

\textsuperscript{28} Adam John and Matthew Fielding, “Rice Production Constraints and ‘New’ Challenges for South Asian Smallholders: Insights into De Facto Research Priorities”, \textit{Agriculture & Food Security}, Vol. 3, No. 18, 03 December 2014, pp. 2-16.

rotation has changed, to reflect improved knowledge and experience. The study compared the profitability of the organic and conventional cash grain rotation during 1981-1995. Net returns were calculated in two ways: with only cash costs included, such as seed, machinery and chemicals; and with non-cash costs also included, such as unpaid family labour, operator management skills, and the cost of making the transition to an organic system.

The results showed that the organic rotation can generate total returns per acre comparable to those of the conventional rotation. During both 1986-90 and 1991-95, net returns which was computed by subtracting explicit costs from revenue was higher for the organic rotation than the conventional one. The organic rotations during those five years periods produced corn and soya-bean yields comparable with the conventional rotations, but grew higher value crops less frequently and required more family labour and management.

Delate, et. al. (2001)\textsuperscript{30}, studied the economic performance of conventional and organic systems in Iowa for three years of production (1999-2001). The data were collected from the Neely-Kinyon long-term Agro-ecological Research site, which was established in Iowa in 1998. The Neely-Kinyon Farm Association dedicated a 17 acre block for the long term study. After meeting with the focus groups and the Neely-Kinyon Farm Association an experimental design was developed to evaluate typical rotations. Treatments in the Long Term Agro-ecological Research experiment were established in randomized design with four replications and included conventional corn-soya-bean, organic corn-soya-bean-oat, corn-soybean-oat-alfalfa and soya-bean winter rye. Organic fields were fertilized to provide equivalent rates of nitrogen as in conventional fields with locally produced swine hoop-house. And conventional fields were fertilized and pests were managed following Iowa State University recommendations.

The results showed that for corn within the organic corn-soya-bean-oat and corn-soya-bean-oat-alfalfa rotations were significantly greater than conventional corn-soya-

bean 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 soya-bean within the organic corn-soya-bean-oat and corn-soybean-oat-alfalfa rotations were not significantly different at $470/acre and $505/acre, respectively. Organic soya-bean returns were significantly greater than conventional soybean crop returns ($95/acre) in the corn-soybean rotations.

Singh and others (2007)\(^{31}\), conducted a field experiment at the research farm of Indian Agricultural Research Institute, New Delhi, India during 2003-06 on rice-wheat-green gram cropping system, an experiment conducted to check the feasibility of organic farming in rice and to examine its impact on the yield and quality of grain and soil properties. In the experiment, different treatments comprising organic amendments, such as Blue Green Algae (BGA) 15kg/ha, Azolla 1.0 tonne/ha, Vermicompost and Farm Yard Manure (FYM) 5.0 tonne/ha each applied alone or in combination were tested in organic crop production. These treatments were compared with absolute control Nitrogen (N\(_0\)) Phosphorus (P\(_0\)) Potassium (K\(_0\)) and recommended dose of chemical fertilizer (N\(_{80}\) P\(_{40}\) K\(_{40}\)). In wheat crop Azotobacter replaced Azolla, but other treatments remained same. For rice, a scented variety ‘Pusa Basmati 1’ and for wheat and green gram High Yielding Varieties of Seeds (HYVs) were taken. Biomass of green gram was incorporated in soil after picking of pods and wheat was sown using zero tillage practice. The observations on grain yield, contents of Iron (Fe), Zinc (Zn), Manganese (Mn) and Copper (Cu) in rice grains, insect pest incidence, soil nutrients and microbial activity were taken.

The results revealed a significant enhancement in grain yield of rice over absolute control, due to the application of different organic amendments applied alone or in combinations. Rice grain yield increased by 114 to 116.8 percent over absolute control when all the four organic amendments were applied altogether. The rice grain yield (4.0 t ha\(^{-1}\)) obtained under combined application of four organic amendments was at par with the yield recorded under recommended dose of chemical fertilizer application. An

interesting observation recorded was that there was no serious attack of any insect pest or disease in organically grown crop. Soil microbial population (Actinomycetes, Bacteria, Fungi and BGA) enhanced due to the application of organic amendments in comparison to absolute control as well as recommended fertilizer application that in turn resulted in a notable enhancement in soil dehydrogenase and phosphatase enzyme activity. Soil organic carbon and available phosphorus contents were also found to be significantly increased, due to organic farming practice over control as well as chemical fertilizer application. Rice grain analysis for nutrients, viz., Fe, Zn, Mn and Cu, showed a significant increase in Fe and Mn content in the treatments having two or more organic amendments over control. Zn and Cu content also increased but the increment was significant with combined application of three or four organic amendments. Thus, the study revealed that addition of four organic amendments, viz., BGA, Azolla, FYM and Vermicompost, could give the optimum yield (4.05 t/ha) of organic Basmati rice and improve grain and soil quality.

Bhadoria and Prakash (2008)\textsuperscript{32} carried out a field experiment to evaluate the relative efficiency of organic manures in combination with chemical fertilizers against application of only chemical fertilizers in improving the productivity of rice in a lateritic soil. The study was undertaken in the experimental farm of Indian Institute of Technology, Kharagpur, situated in the lateritic belt of south-western region of West Bengal, India. It was conducted during wet season (June-November) in the year 1997 and 1998 using rice Pusa Basamati. Organic manures were applied at 50 percent recommended Nitrogen equivalent basis and balanced with chemical fertilizers to attain the recommended Nitrogen, Phosphorus and Potassium levels. The effect of three commercial manures: processed city waste + chemical fertilizers, vermin compost + chemical fertilizers, oil cake pellets + chemical fertilizers and locally available farmyard manures + chemical fertilizers were assessed in comparison to chemical fertilizers.

The results indicated that organic manure treatment in balancing with chemical fertilizers to the recommended dosage of Nitrogen, Phosphorus and Potassium favoured higher dry matter production and grain yield, as compared to application of only chemical fertilizers. Among the different manures tested, the increase in yield was maximum with farmyard manures + microbial culture + chemical fertilizers and minimum with oil cake pellets + chemical fertilizers. The percentage increase in grain yield of different organic treatment plus chemical fertilizer over chemical fertilizer only varied from four percent for oil cake + chemical fertilizers and 26 percent for farmyard manures + microbial culture + chemical fertilizers, respectively. The uptake of Nitrogen, Phosphorus and Potassium by rice plants was significantly greater in treatments with organic manures in combination with chemical fertilizers. Among the commercial manures, processed city waste + chemical fertilizers showed high promise and emerged as a potential alternative to farmyard manures.

Egri (2008)\(^{33}\), studied the socio-demographic, farm-related, attitudinal and communication behaviour differences between organic and conventional farmers in Canada. During 1991-92, personal interviews were conducted with 118 organic and 85 conventional farmers located throughout British Columbia (113 farmers), in Southern Ontario (41) and in South-Central Saskatchewan (49). Farmers’ production method was kept as the dependent variable and four types of independent variables were used, i.e., socio-demographic, farm-related, attitudinal and communication behaviour. Tools like ‘Synthetic Agrichemicals in Farming’ was used to measure respondents’ beliefs concerning the negative consequences of growth and technology, ‘Perceptions of Organic Farming scale’ was used to measure the respondents’ attitude concerning the economic or production benefits of organic farming, ‘Ranking of Information on the criteria of Relevance, Clarity and Trust’ was used to check farmers’ perceptions of agricultural information sources and ANOVA analysis was conducted for the study.

It was found that while organic farmers had fewer years of farming experience, operate smaller farms and are less dependent on hired farm labor. The most significant difference between Organic and Conventional farmers concern their ranking of information source. Organic farmers gave significantly higher rankings to farmer and farm organizations while Conventional farmers gave higher rankings to Government and Agri-business as information sources. The results of the Logistic Regression Analysis conducted, showed a positive sign for the association of variables with the Organic farmers groups, whereas a negative sign for the association of variables with the Conventional farmers groups.

Vogl, Kilcher and Schmidt (2008)\textsuperscript{34}, studied about the on-going controversial debate on the development of organic farming and global trade of organic procedure between North and South. The authors aimed to collect and structure the arguments of the current discussion, to begin assessing and commenting on some of them and to give some suggestion for future development. The study was based on a review of literatures, on the authors’ experience in projects of organic food production and processing in cooperation with organic farmers in different parts of the world and on authors’ experience as auditors in the accreditation of certification bodies in Europe and Latin America.

It was concluded that organic agriculture helps farmers return to their local knowledge, and it gives them renewed possibilities for maintaining and developing their local sustainable farming systems. Regulatory mechanisms were found needed, but with a new ethical approach allowing regional definitions, local identifications and innovations. Regional farming systems also need to allow regional standards and regional quality control systems with justified diversification instead of being overrun by global harmonization.

Lotter (2008)\textsuperscript{35}, reviewed earlier works related to organic agriculture, with the view to study the sustained high rates of growth in sales of certified organic products in


the U.S. and world-wide. The study showed that the global organic product market value was estimated to be $20 billion in 2001, and the organic product share of total food sales was nearly two percent in the U.S. and one to five percent in European countries. Processed organic products had shown particularly rapid growth, often over 100 percent. Commercial certified organic agriculture had spread to over 130 countries world-wide. Demand for organic products was driven by the belief that organic products were more healthy, tasty and environmental-friendly than the conventional products. Evidence for these beliefs was also reviewed. The author opined that comparative research was needed on organic products and conventional products. He found that the organic agriculture systems consistently out-performed conventional agriculture by up to 100 percent.

Milestad and Darnhofer (2008)\(^{36}\), applied the concept of resilience to the farming system. The term resilience had three essential features they are the quantity of change which any system can endure while maintaining its function and structure, the level of self-organization, and the ability for learning and acceptance. The objective of the study was to understand which features were contributing to building farm resilience and which factors of the existing socio-economic surroundings could prevent them from fulfilling their ability to the fullest. And thus the relationship between sustainability and resilience was first examined and then the characteristics defining farm resilience were compared to the basic principles of organic farming. Finally the effect of putting the advancement of organic agriculture at risk was studied to check their maximum effect on farm resilience.

The study concluded that organic farming was in fact encouraging resilience, however the ability of organic farming to help farm resilience was fully depending on the elasticity of the organic farming movement, which means it should be allowed to manage, innovate and become accustomed and the farmers should be capable enough to develop a substitute food system that can adjust with the global industrial food system. When the present expansion of organic farming and its impacts on government regulation and market dynamics were analyzed, it was found that there was a threat that this quality was gone. And therefore, to ensure farm resilience adaptation alone was not enough, the

elasticity of the organic farming movement also played a very vital role in realizing its resilience building ability.

Degenhardt, Martin and Spaner (2008)\(^{37}\), studied one-third of the Alberta organic using a random sampling technique during the 2002 in order to acquire the knowledge of their crop and commodity selection procedures, land usage, fertility management, perceived research needs and recognized constraints to sector feasibility. The data collected were tabulated and presented in a descriptive manner, estimates like means and standard errors were calculated. And the statistics from the farmers of the survey area were further compared to those presented in the survey conducted by Alberta Agriculture, Food and Rural Development (AAFRD) in 2000.

The findings showed that the study area 40 percent of the land was cropped to cereals 45 percent of the farms raised organic cattle and only 35 percent were pasture and forage land. The study showed that the main problems faced by the organic farmers were the problems of related to markets, soil fertility, weeds and production costs. The study also showed that organic farmers in Alberta, both in the study area and across the province, have not been using the artificial goods and have been certified for close to half of the years and 60 percent of the farmers from within the study area had switched to organic farming.

Mendoza (2008)\(^{38}\), conducted a case study to determine the positive impacts of organic farming in rice farming. The study was exclusively related to the farm households, labour utilization, farmers’ association, soil condition, rice paddy ecosystem, comparative economics and energy use of organic rice production, and Low External Input and Sustainable Agriculture (LEISA), and conventional rice cultivation. Pinamalayan and Puli Pinamalayan of Mindoro Island was selected for the study, which was conducted during December 2001. Methods like Farmers’ Group Discussion (FGD)


and Individual Farmer Interview (IFI) were used in study. In case of the FGD, the participants were asked detailed to open-ended questions. Farmers were grouped into three to collect answers to the questions.

The result showed that compared to conventional farming, organic farming has used only 33 percent of the cash capital. Women were observed to be in control of family expenditures. As a result of the reduction in cash capital expenditures in organic farming women were relieved from the burden of providing credit to finance crop establishment. The study also showed that the increased labour requirements of organic farming, like in spreading of rice straw, preparing and applying compost, weeding and picking up of the golden snails were handled easily due to the support team work of the family members. The author concluded that the soil quality showed a better result due to organic farming, and all organic rice farmers who had been selected for the study were members of the farmers’ organization and cooperative, and only few conventional farmers were found to be members of farmers’ organization. And finally the net revenue of organic farming was found to be higher than the conventional farming, even though the yield achieved in organic farming was lower as compared to that of the conventional farming.

Lopez (2008)\textsuperscript{39}, conducted the study to find out more about the situation in the organic sector in Catalonia and Galicia, Spain, during 1991-2004. Data were collected through the method of interview which was based on mixed questionnaire. The main motive of the study was to test the opinions and perceptions of the respondents involved in organic farming. Thus a qualitative approach was chosen for the study and 477 respondents were selected in Catalonia and 19 in Galicia. Based on the research, four types of organic farmers were observed in Catalonia and Galicia. First, was the ecologically aware, which included both full-time and part-time farmers, who fully aware of environmental and social responsibility and were extremely concerned about the global issues. It was observed that 51.1 percent of the Catalan farmers were included in this category with an average age of 40.3 years, while in Galicia it was only 26.3 percent with an average age of 35.8 years. Second, were the realistic, they were the middle-aged

producers who were financially sound, which included the medium sized and large farmers. It was found that 23.4 percent of the Catalan farmers were within this age group and 31.6 percent were the Galician farmers. The third group were the bonus hunters, who were the runaway landowners or part-time farmers. Their only interest was in acquiring agri-environmental subsidies. In Catalonia, 19.1 percent belonged to this category and 21 percent were the Galician farmers. Finally, the last group was the pre-productivist farmers who owned small, under-capitalised farms, and were on the verge of retirement. About 6.4 percent of the Catalan organic farmers belonged to this group and 21 percent of the Galician farmers, belonged to this category.

Grunbacher and Kromp (2008)\textsuperscript{40}, studied about the occurrence of wheat bugs in organic farming of Eastern Austria. The study was performed in the year 2004 in order to check the importance of the wheat bug occurrence. The seven sites selected for the study were the municipalities Halbturn, Frauenkirchen, Steinberg-Dörfl, Lutzmannsburg, Donnerskirchen, Oggau and Zillingtal, in Burgenland, Eastern Austria. Each site consisted of several fields and adjacent uncultivated areas, representing different biotopes of the regional agricultural landscape. 368 individuals in total were selected from 22 species of bugs were collected by sweep-net.

The result suggested the recent occurrence of wheat bugs in Eastern Austria might have been due to the considerably above average temperatures during the years 2000-03.

Muller (2009)\textsuperscript{41} has opined that organic agriculture which is a revised approach to climate change and variability was a better and capable option for rural communities. According to him, a well-established practice could build through adaptation and mitigation based on organic agriculture, because organic agriculture was a sustainable living strategy with its usage in different climate conditions and under variety of specific local conditions. Further, the financial requirements of organic agriculture as an

\textsuperscript{40} E. Grünbacher and B. Kromp, “Investigations on the Occurrence of Wheat Bugs (Scutelleridae, Pentatomidae; Heteroptera) in Organic Farming of Eastern Austria”, 1\textsuperscript{st} Scientific Conference within the Framework of the 8\textsuperscript{th} European Summer Academy on Organic Farming, Lednice na Morave, Czech Republic, September 3–5, 2008, pp. 1-4, Accessed on 11/07/2012.

\textsuperscript{41} Adrian Muller, “Benefits of Organic Agriculture as a Climate Change Adaptation and Mitigation Strategy on Developing Countries”, Environment for Development, Discussion Paper Series, Sweden, April 2009, Accessed on 01/10/2012.
adaptation or mitigation strategy were low. The author suggested that advance research was required on productivity of organic agriculture and its mitigation, and sequestration potential. The other critical points were information condition and institutional structures, such as market accessibility.

Dubey and Dubey (2009)\textsuperscript{42} conducted a field experiment with the aim to estimate the impact of organic fertilizer in improving the soil quality and the productivity of Rice. The experiment was performed at the research farm of Kilpest India Ltd., Bhopal, during Kharif seasons 2009-10. Scented variety Pusa Basmati-1 rice variety of was chosen for the study. Different treatments such as Blue Green Algae (Chlorella pyrenoidosa, and Nostoc muscorum), biological Soy hydrolysate, and Fytozyme each were applied to test the organic crop productivity. Then the results of these treatments were compared with the recommended dose of Fytozyme which is used as an organic fertilizer all over the world.

The authors concluded that treatments caused a significant raise in shoot and root length compared with those under control. The best result was observed in case of the Chlorella pyrenoidosa treatment followed by biological Soy hydrolysate, Fytozyme and Nostoc muscorum. It is finally found that both the grain and straw yield showed a positive and significant result with the plants treated with different fertilizers. Thus, concluded that organic product was a better feasible product.

Saha and Mishra (2009)\textsuperscript{43} evaluated the long-term effects of different locally available jungle grasses and weeds on soil hydro-physical properties and rice yield through a five year field experiment (2000 to 2005) at the Indian Council of Agriculture Research (ICAR) Complex for North Eastern Hilly (NEH) Region, Umiam, in Meghalaya, India. The objective was to determine whether locally available grasses (jungle grass) and weeds (Ambrosia Sp) could be used as alternative sources of organic


materials for lowland rice in scarcity of Farm Yield Manure (FYM). Each year, 25-day-old seedlings of rice were transplanted at 25 x 15 cm spacing during the first week of July and harvested in November. The whole experiment was conducted in a completely randomized block design. Soil samples were taken at harvest after completion of fifth cropping cycle, and the soil physical parameters were subsequently analysed using International Pipette method for the textural components and for organic carbon by Wet Oxidation method. Statistical analysis was carried out using standard analysis of variance. The significance of the treatment effect was determined by t-test, and the significance of the difference between the means of two treatments was determined using Least Significant Difference (LSD) computed at five percent probability level.

The results showed that incorporation of FYM or jungle grass or Ambrosia sp continuously for five years in puddle rice soil improved soil organic carbon (SOC) by 21.1 percent. FYM treated plots showed marginally higher yield than jungle grass and Ambrosia treatments, due to the fact that jungle grass and weeds, being under-composed organic materials, prolonged the immobilization period of Nitrogen and was therefore responsible for the slightly less yield than FYM. However, as these grasses and weeds contained higher nutrient levels than FYM and increased the Soil Organic Carbon (SOC) slowly, these organics may serve as alternative to FYM and may have a dramatic effect on long-term productivity of rice. The gradual improvement in soil physical properties led to a significantly higher yield of rice. Finally it was concluded that the application of organic manure or organic residue annually might mitigate the negative effect of puddling and the related properties, which could therefore contribute to the sustainability of the wetland rice ecosystem.

Rattanasuteerakul and Thapa (2009)\textsuperscript{44} tried to trace the evolution of organic vegetable farming, particularly in the Mahasarakham province of Thailand and analyzed the spatial pattern of organic vegetable farming and its determinants. The study focussed on the spatial analysis of Organic Vegetable Farming (OVF) in Mahasarakham province, and was based on primary data collected through household surveys, group discussion

and key informant surveys. The authors also relied on secondary information collected from Government offices such as Department of Agricultural Development, Mahasarakham province and NGOs including the Alternative Agriculture Network. Thus during August 2006 to January 2007, 172 farmers were surveyed from four districts-Mueng, Borabu, Kosum Phisas and Na Chuak. Slightly more than half of the officially designated organic vegetable farmers were genuine organic farmers, while others were mixed vegetable farmers who used both organic and inorganic inputs. There was variation in the intensity of organic vegetable farming from one district to another due primarily to variation in soil suitability, availability of irrigation water and external support.

Stofferahn (2009) conducted a study during February- March 2006, in collaboration with the Foundation for Agricultural and Rural Resources Management and Sustainability (FARRMS) to determine those factors that predicted farmers’ classification into organic and conventional farming categories. The sample for this study was all of North Dakota farmers in United States of America (U.S.A) including those who farm organically and those who farm conventionally. Taking classification of farm type as dependent variable and reasons to farm organically as independent variables, tools and scales like Alternative Conventional Agriculture Paradigm (ACAP) scale, logistic regression analysis and reasoning were used in the study.

The results of the analysis found support for the environment-ethical motivating factors but not for any of farm structural factors and for only one of the personal demographic factors. In Logistic regression analysis, three most important explanatory factors taken were ACAP production orientation, environmental or ethical reasons and ACAP farming orientation. This analysis confirmed that the ACAP scale would accurately classify producers into alternative and conventional categories. Economic reasons were also able to classify farmers into organic and conventional categories.

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Brahmanand, Ghosh and Sahoo (2009)\(^46\) conducted a field experiment at the research farm of the Water Technology Centre for Eastern Region (Indian Council of Agricultural Research), Bhubaneshwar, India, to study the effect of organic and inorganic sources of nitrogen fertilizer on nutrient use efficiency and productivity of rice and rice-fish farming systems. The experiment was laid out in split plot design with two main plot treatments under three replications: M1- Sole rice cropping, M2- Rice-fish farming, S1- Control (no nitrogen), S2-25 percent N (nitrogen) through organic source, S3-50 percent N through organic source, S4-100 percent N through inorganic form. With the increase in inorganic sources of N, the rice crop responded positively in terms of grain yield and other yield attributes. The highest grain yield, straw yield, panicles and filled grains panicle of rice were recorded when nitrogen was applied in 100 percent through inorganic form. Similarly, the agronomic efficiency and apparent recovery were found to be maximised when nitrogen was applied in 100 percent inorganic form. The productivity of rice was however found to be higher when fish was integrated into the system.

Alonso and Guzman (2010)\(^47\) evaluated the contribution of organic farming to the increase of energy efficiency in Spanish agriculture. To achieve the objective, comparative studies were carried out on 78 organic crops and their conventional counterparts. Primary data were obtained through direct survey in different areas of Spain between March and July 2006. Statistical analysis used was Wilcoxon matched pairs test for paired samples through the SPSS 15.0 software for Windows.

The results indicated that in majority of the groups, energy output values obtained were lower for the organic crops than for the conventional crops. In case of total energy input (EI) the opposite occurred, i.e., average energy use was higher in all the organic groups. Higher EI is closely related to the use of renewable energy (RE) and so average RE use is significantly higher in all the organic groups. In comparative terms, the use of


RE was 74 percent lower in conventional crops overall. Thus non-renewable energy efficiency was higher in organic farming, whilst the consumption of this type of energy was lower in Spain. For this reason, although certain qualifications were made regarding the factors which could influence the results, an increase in the land area dedicated to organic farming could considerably improve the energy sustainability of Spanish agriculture.

Das, et.al. (2010)\textsuperscript{48} made a field experiment during the kharif (rainy) season of 2005-06 at the lowland farm, Division of Agronomy, ICAR (Indian Council of Agricultural Research) Research Complex for North Eastern Hilly (NEH) Region, Umiam, Meghalaya, India. The objective was to study the effect of eight composts prepared from four different types of plant biomass, like rice straw (oryza sativa), eupatorium adhenophorum, lantana camara and grass/weed mixtures, following two composting procedures: Microbial Enriched Compost (MEC) and Microbial and Nutrient Fortified Compost (MNFC) on productivity of lowland rice. Recommended NPK (80:60:40 kg ha\textsuperscript{-1}) and farmyard manure (FYM) at 10t ha\textsuperscript{-1} treatment were also kept for comparison. In general, the performance of rice under MNFC compost was superior to MEC compost. The results revealed that the grain yield of rice with rice straw MNFC compost and eupatorium MNFC compost were five percent and three percent higher than recommended NPK, respectively. The nutrient uptake and post harvest soil fertility status were also significantly higher under these treatments compared to the recommend NPK. Although the increments in grain yield of rice with various composts were not much during two years’ experimentation, substantial improvement in soil fertility in terms of available NPK were observed.

Das, et. al. (2010)\textsuperscript{49} conducted a study to utilize obnoxious weeds as a source of plant nutrient and to compare different sources of composts with respect to their nutrient


composition and influence on rice productivity and soil health. The experiment was made at the lowland farm, Division of Agronomy, Indian Council of Agricultural Research (ICAR) Research Complex for North Eastern Hilly (NEH) Region, Umiam, Meghalaya, India, under irrigated conditions in 2004-06. The eight treatment combinations of four substrates (plant-biomass used for composting) and two methods of composting were tested in a randomized block design and replicated three times. The high yielding rice variety ‘Sahsarang’ was used in the experiment. The plant and soil data (i.e., the grain and straw samples of rice collected at harvest) were statistically analysed using analysis of variance (ANOVA); treatments were considered significantly different based upon the F-test at five percent level of significance, and for microbial counts one percent level of significance was considered. The study indicated that composts prepared from rice straw and Eupatorium was nutritionally superior to other sources. It had special significance for North-East India and the sub-tropical Indian Himalayas. And thus the authors suggested that the use of organic manures, like enriched composts along with non-chemical pest-disease management, would support organic food production in North-Eastern Region of India.

Gundogmus (2010) studied about energy efficiency in organic farming in Aydin Province. The number of organic fig producers was 887. Data were collected for a three-year period (2002-04) through the use of repeated semi-structured interviews with farmers and corroborated with farm visits and record reviews of the companies or fig sales cooperatives to which the crop was sold. In addition, secondary data were obtained for some calculations from the agricultural Directorate, the Farmer’s Chamber, agricultural input supplies, fig sales cooperatives, the Industry and Trade Chamber of Aydin Province and the Izmir Commodity Exchange.

Tools like Energy Equivalents and for the analysis of fig production to producer’s welfare, partial budget analysis was done. Energy equivalents of the inputs used in fig production was calculated using conversion factors (diesel oil = 56.31 MJ) and was expressed in MJ /ha$^1$. The energy ratio was found by dividing the total energy

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equivalents of the inputs into the total energy equivalent of fig yields in each production system. Statistical tests for significant differences in mean values of energy input uses across the production systems was calculated using t-test for two samples with unknown variances. For the analysis of fig production to producer’s welfare, partial budget analysis was done. Total production costs and unit cost of product were calculated by utilizing variable costs and fixed costs such as depreciation, interest, management, and maintenance. Productivity was calculated from interviews with farmers. Net income of fig production activity was calculated as gross product value (GPV) minus production costs. The benefit/cost ratio was calculated by dividing GPV by total production costs.

The study showed that there is considerable potential for improvement. The research results showed that a total of 4,463.22 MJ of total energy input used per hectare on organic fig production was renewable energy, which was 2,578.91 MJ/ha higher than that of conventional fig production. That is, 41 percent of less non-renewable energy was used on organic fig production per hectare than in conventional fig production. And total production cost per hectare was higher on organic farms. And also, the mean GPV and net incomes on organic dried fig production were calculated as six percent and seven percent higher than those of conventional production respectively. The benefit/cost ratio of fig production calculated was nearly the same in both production systems.

Kizos, Veikontis and Ignacio (2010)\textsuperscript{51} compared the economic and environmental elements of organic and integrated farming systems for a very intensive cultivation of sultana table grapes in the Prefecture of Korinthos in Greece. The data were collected from 30 farmers of each system. Interviews were conducted from April to August 2008. Data from the Agriculture and Livestock Census of 2000 were also used. T-tests were employed for statistically significant differences of the averages of the two systems, along with Chi-Squares and Pearson’s Linear Correlation.

The findings showed that most of the farmers were middle aged, 45.6 on average for organic and 46 for integrated farming, with 70 percent from 30 to 50. Only four farmer heads were women, three in organic and one in integrated farming. All integrated

farming farmers declared that they were ‘professionals,’ compared with 73.3 percent for organic, the rest having other occupations as well. The size of the plots with sultanas correlated positively with the overall size of the farms for both systems (Pearson’s $r = 0.71$, $p < 0.001$ and $0.46$, $p < 0.05$ for organic and integrated farming farms respectively), but not with the age of the farmer or the size of the household or the family income class. Five different types of fertilization practices were recorded, complex inorganic, organic, animal dung, plant hormones and leaf fertilization. Sultanas could either be sold as table grapes, as raisins and for wine. In the sample, almost all farmers had sold all their productions as table grapes. Organic farmers produced 7,939 kg per hectare compared with 11,449 kg per hectare for integrated farming farmers. The gross revenue was calculated for each farm according to the price they declared per quantity and was significantly higher for integrated farming farms’ Revenues per hectare were not correlated with the age of the farmer or the size of the plots of the farm with sultanas or with the farm income class, but were correlated for both systems positively and very strongly with the gross production of sultanas per hectare, as expected. The opinions of farmers obtained on certain issues stated that concerning the reasons for selecting the particular system, organic farmers regarded economic (better prices and guaranteed sale), and health reasons (protection of my health) as the most important and in general the safety of the products and the minimum use of resources as important. On the contrary, all integrated farming farmers said that the particular system and the certification it produced was necessary for exports and this was the main reason why they had chosen it.

Sheahan and others (2011) conducted explorative research to determine what challenges small-scale organic farmers faced in choosing their particular production, marketing and organizational strategies in Miami-Dade country. The analysis was based on data collected from soil surveys, semi-formal interviews, participant-observation, secondary sources and available reports, baseline economic data on the status of organic farming, alternative agriculture research funding, and tomato production in Florida as obtained online through the United States Department of Agriculture National Agriculture Statistics Service. The farms surveyed for this article were a two five acre

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farms that specialize in growing micro-greens and sprouts for high-end restaurants in Miami Beach, out of which one was certified bio-dynamic and the other was not certified organic, but was pesticide free and both of these farmers practiced no-till management in raised beds, a two five acre, certified organic farms that were developed as community supported agriculture, of which one was successful and well developed and the other was in an early stage of development, a 75 acre certified organic farm growing beans and squash using conventional tillage which was the only relatively large-scale commercial organic producer in the sample; and a seven acre non-certified organic orchard specializing in mangos and avocados. Soil samples were also taken from each farm after semi-structured interviews on soil management practices. And sixteen composite samples were collected from late February to mid-March 2006. Interviews were conducted using tape-recorder.

The results showed that the farmers in the study identified lack of micronutrients, lack of organic matter, weed infestations, mosaic disease, and the lack of diversity in the crop species to make rotations effective as being the greatest soil limitations on the farm. The results of the preliminary study found that although all organic farmers in the survey group felt that NOP standards imposed significant burdens upon their operations and management autonomy, the interpretation and ecological results of these practices are extremely varied between the farms. Perhaps the greatest cost constraint to organic farmers was securing affordable and dependable labor throughout the season. Overall, several farmers reported very low returns to their fixed and variable production costs. The largest costs reported among farmers surveyed were for labor, organic slow release fertilizer, manure, woodchips, certified seeds, and organic hay used for mulch and horse feed. Thus the study indicated that soil health varies dramatically from farm-to-farm, inputs and labour constituted significant costs, and marketing, production and organizational strategies showed no signs of immediate growth.

Kaufman and others (2011) made a study to investigate if financial support was the dominant reason for increasing diffusion in Lithuania and to understand why majority

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of the farmers still do not convert in face of high financial support. The study is the first attempt to evaluate the diffusion of organic farming practices in Lithuania more comprehensively. In 2004, the Lithuanian Institute of Agrarian Economics (2005) carried out a survey of organic farmers only. In contrast, the present study investigates what differentiates organic and conventional farmers, and what can be learned to adapt policy making towards a more effective and efficient diffusion path. The study was based on several secondary data sources and interviews with organic and conventional farmers that were combined in a triangulate fashion. Secondary data sources included the Agricultural Census of 2003, and data from the Lithuanian certification agency for organic farming and the Farm Accountancy Data Network (FADN). A survey was conducted during spring and summer 2005, which aimed at studying farmers’ personal, structural and perceived institutional influences encouraging or distracting from conversion to organic farming practices, and was based on fully structured interviews covering groups of questions about the farm, the farmer, memberships in farming organisations, used information sources and attitudes, support schemes, and were completed during one-to-one interviews with the farmers or the managers of the farm. The questionnaire included the same questions for both organic and conventional farmers and sets of questions for only one of the two groups. Panevežys County was chosen for the survey as it showed the highest diffusion rate for organic farming in 2004 and the whole region was served by the same extension service agency. And logistic regression was performed using 102 non-adopters and 100 adopters with the SPSS complex samples option. The logistic regression model was specified as a function of information search, social capital, attitudinal, economic, and farm related variables as,

\[ y_i = \beta_0 + \beta_1 (\text{Info G}) + \beta_2 (\text{Disc O}) + \beta_3 (\text{OF management}) + \beta_4 (\text{Value}) + \beta_5 (\text{Farm type}) + e_i \]

where, \( y_i \) is the log odds of adoption for the \( i \)th farmer, and \( e_i \) is the base of natural logarithms; \( \beta_0 \) is the intercept constant, the beta weights represent the relative contribution of each independent variable.

The study showed that joining the European Union led to an increase of financial support for Lithuanian farmers overall, and especially for organic farmers. Since then adoption of organic farming has increased strongly. Apart from the main conclusion, that
the finances and the onsite management of organic farming were the main determinants for diffusion. The survey also showed first indications for land capitalisation effects caused by relatively high direct organic subsidies. Thus, it had some merits to discuss how they wanted to see the more marginal areas in Europe to look like in the medium to long-term future as it could be possible that area-based subsidies lead to a considerably altered landscape in these regions. As the Lithuanian agricultural system was currently developing somewhat faster to adjust to European Union and world market conditions, one could interpret this stage as a special opportunity to make steps towards a sustainable food system. In conclusion, the authors recommended balancing direct subsidy levels with investments into support infrastructure and market development to increase the effectiveness of the whole organic farming systems.

Adhikari (2011)\textsuperscript{54} studied the economic performance of organic farming in general and that of organic rice production in particular in Chitwan in 2010. The study showed that the average productivity of organic rice production was 3.15 Mt/ha which was observed to be higher than the national average. It was also found that among the factor cost, labor cost contributed the highest to total cost of production, while poultry manure cost, human labor cost and oil cake cast were found to be significant factors at five percent level to contribute to total revenue. The benefit-cost ratio of organic rice production was found to be 1.15.

Neira and others (2012)\textsuperscript{55} contributed to the debate on the energy performance of organic farming and, particularly, to analyze the energy performance of the organic farming sector in Andalusia through the application of the energy analysis methodology. The energy assessments presented in the article was based on the empirical data provided by 250 organic farms surveyed in 2006-07, in Andalusia. With this purpose, organic farming was studied in relation to its output, inputs (direct energy, indirect energy and


capital energy), and energy efficiency, as well as other energy indicators, both in an aggregate manner and by large groups of crop.

In practice, energy analyses make a partial application of the principles of lifecycle analysis and the calculated system levels vary from one study to the other. The energy analysis of organic farming in Andalusia had been made by using synthetic indicators linked to the sector’s output, inputs and energy efficiency by crops groups.

Energy Productivity \( (EP)_{(i)} = \text{energy output } (EO)_{(i)} (\text{MJ}) \times \text{area}^1 (A)_{(i)} (\text{ha}) \)

The results showed that the energy efficiency of organic farming had improved and reached 2.02 when calculated exclusively in terms of non-renewable energy, given the important contribution of renewable energy from organic fertilization. The explanatory factors of the energy performance of organic farming were related to the system’s output and inputs. The determinant factors of the energy inputs showed the dependence on non-renewable energy sources of organic farming. Agricultural mechanization, the consumption of diesel and derivatives and machinery, as well as the consumption of electric power in irrigation systems were the three main factors determining the non-renewable energy origin of 69.1 percent of the energy requirements of organic farming in Andalusia in 2005.

Kumar (2012)\(^{56}\) applied standards-based life-cycle assessment to compare the cradle to farm gate greenhouse gas emissions of 12 crops products grown in California using both organic and conventional methods during 2006. The agricultural production data for the 12 organic and conventional crop products, consisting of information such as production region, yield, management practices, inputs and other details had been extracted from the detailed cost and return studies published by the university of California. In addition to analyzing steady state scenarios in which the soil organic carbon stocks were at equilibrium, the study modelled a hypothetical scenario of converting each conventional farming system to a corresponding organic system and examined the impact of soil carbon sequestration during the transition.

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The results showed that steady-state organic production had higher emissions per kilogram than conventional production in seven out of the 12 cases. Transitional organic production performed better than steady-state organic. The results demonstrated that converting additional cropland to organic production might offer significant Green House Gas reduction opportunities over the next few decades by way of increasing the soil organic carbon stocks during the transition. Non-organic systems could also improve their environmental performance by adopting management practices to increase soil organic carbon stocks.

Yahya and Wong (2013)\textsuperscript{57}, studied the technical and economic aspects of organic rice farming in Taiwan. In order to have direct observation and information of organic rice managing process, organic rice field and agricultural district were visited. The data were collected by using interview method. Secondary were also used for the study, such as Agriculture and Food Agency (AFA), and Yilan and Hualien Organic Agriculture (HDAIS), etc. The results showed that the farmers were getting good income from their rice production, mostly due to the high demand for organic rice in Taiwan.

Husnain and Khan (2015)\textsuperscript{58} examined the viability of organic agriculture in Pakistan and made a comparative study of organic and conventional wheat and rice production in terms of yields, costs, soil health and profits in the Sheikhupura, Gujranwala and Okara districts in Punjab. The study showed that organic farmers relied on organic fertilizers and pesticides, while conventional producers applied pesticides like Logran, Bernoxil Safinor and Proton. The study also proved that organic farming was as profitable as conventional farming, due to the lower input cost and higher output prices. While yields in organic farms tend to be lower than conventional farms however these farms did better in terms of soil health.


Nghia and Dzung (2016)\textsuperscript{59}, evaluated the economic and environment, as well as society effectiveness of organic rice production in My Duc District, Hanoi, Vietnam. Field investigations were conducted during the year 2007-09 (before the establishment of projects) and during 2013-15 (after the completion of projects). Details of farming practices and chemical or organic fertilizer application were obtained using interview method with both conventional and organic rice farmers. The researcher observed that both organic and conventional farmers used rice variety Bac Thom 7, which is indica variety with rice quality of aroma, deliciousness, stickiness, and medium yield. Based on the data collected, the cost for farming and amount of labor required for farming were calculated. The economical effectiveness for both organic and conventional rice production was measured using the following functions:

1. Total variable cost = $\Sigma$ Cost of all variable inputs = Cost of land preparation + Cost of fertilizer + Cost of human labor + Cost of other inputs.

2. Gross return = Returns from grain + Return from straw


The study proved that organic rice production not only generated high economic effectiveness, but also strongly contributed to improving soil environment better. The study also showed that the total variable cost incurred was higher by the organic farmers as compared to conventional farmers. Among the cost variables, labour cost was observed to be the highest, and the net income earned was also observed to be higher for organic rice farmers.

2.3 Cost of Cultivation

Hanumantha Rao (1975)\textsuperscript{60} examined the changes in cost and return structure of high yielding versus local varieties of rice per acre in Ferozepur district of Punjab. The analysis was based on the Farm Management data for 1969-70 and the study showed


\textsuperscript{60} C. H. Hanumantha Rao, “Changes in Costs and Returns with the Use of High Yielding Seeds”, \textit{Technological Change and Distribution of Gains in Indian Agriculture}, Macmillan Company of India Ltd., Delhi, 1975, pp. 75-88.
reduction in unit costs and a rise in the share of profits under the high yielding varieties technology. The new technology was cost saving on land, labour and capital. However there was a decline in the unit cost of fertilizers. For high yielding varieties of rice, the expenditure on current inputs was 48.6 percent of the total cost and 41.9 percent for the local variety.

George (1988)\textsuperscript{61} studied the problems related to estimation of cultivation of individual crops. Most of the estimates used three different concepts of cost – cost A, cost B and cost C as adopted in Farm Management studies. The data was collected from the department of Economics and Statistics of the Kerala government on cost of cultivation of paddy (three seasons), coconut, pepper, tapioca, arecanut and ginger from 1980-81 to 1984-85.

The study proved that there are number of problems in estimating the cost of cultivation of individual crops, especially in relation to identification of the items of cost, valuation of different items and specification of the reference group of cultivators.

Ohajianya and Onyenweaku (2003)\textsuperscript{62}, studied the costs and returns structure of rice farming by farm-size in Ebonyi, Nigeria. Pre-tested structured questionnaire were used to collect data through the cost-route approach, which consisted of 40 randomly selected small farmers and 40 purposively selected large farmers during the period of April and December 2000.

Z-Statistics was run using as dependent variable, the value by which the statistical significance of the mean difference is to be judged, and mean net income of large rice farmers, mean net income of small rice farmers, variance from net income of large rice farmers, variance from net income of small rice farmers, number of large rice farmers and number of small rice farmers were used as independent variables. The results showed that rice production was more profitable but no significant difference was observed in the net


income earned by the rice farmers. Finally labour cost was observed to be the major factor of the total variable costs in rice farming and hence was higher for large rice farmers.

Suneetha and Kumar (2013)\textsuperscript{63}, examined the cost and return structure of the paddy production in Andhra Pradesh. Both primary and secondary data were collected through the method of multi-stage random sampling. For the study, two mandals from each district and one village from each mandal were selected. And a total sample of 100 farmers was selected for the study from each district. An exclusive interview method was used for the study, and the collected data were analyzed using suitable statistical tools.

Authors thus concluded that in the study area the highest income was earned by the small farmers in paddy production. The analysis proved that there was a significant difference in the return of paddy between the different groups of farmers. The study also showed there existed productivity profit in production related to labour under advanced production machinery. And finally the total income generated in the paddy cultivation and employment generation was found to be noticeably a satisfaction in Rayalaseema region of Andhra Pradesh.

2.4 Yield Gap

V. Nirmala (1992)\textsuperscript{64} observed the yield gap at farm level in Gokilapuram, Tamil Nadu, between the potential yield and actual yield in the village, with respect to IR 20 and CO 37 rice cultivation. The yield gap analysis revealed that there was a difference between the maximum yield and actual yield under both varieties of rice in the village and the yield gap identified under IR 20 was larger compared to CO 37 variety.

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Fermont, et al. (2009)\textsuperscript{65}, along with the average farm yields, conducted a study on the relationship between crop management, farm management and socio-economic variables. Here, the variables were identified which explained the yield difference. Hence found the factors that contributed to the yield gap. In Western Kenya and Uganda the farm surveys were carried out in three sites. In Kenya during June-September 2004 and in Uganda during October 2005 – April 2006. Using Pearson bivariate correlations the relationship between crop management, farm management and socio economic variables was calculated. The average farm yields were classified into three groups per country: lowest yielding farms, average yielding farms and highest yielding farms. To discover the significant differences between yield classes, Chi-square test was carried out, where the variable behind the yield difference was identified using a linear regression analysis on data from the 2004 and 2005 trials. Hence abiotic, biotic and management factors were marked as independent variables and cassava root yield as the dependent variables. The results showed that the constraints for cassava production differed strongly between sites and year and that many fields were affected by multiple and interacting production constraints.

Ponti, Rijik and Ittersum (2012)\textsuperscript{66} to study the contribution of organic agriculture to the future of world agriculture, an analysis was done on the meta-dataset of 326 published organic conventional comparative crop yields. In 2004 a literature review of organic conventional comparative yield data was undertaken and published in 2010. Using an analysis of variance and the non-parametric method Kruskal-Wallis, the difference between crop groups and regions was tested. Thus for each crop, relative yield was plotted as a function of the conventional yield and computed linear regression lines. Between the organic yield level (Y) and the conventional yield level (X): $Y = a + b \times x^c$, an exponent regression analysis was performed and tested whether $c$ is significantly smaller than 1. By dividing the average organic yield for that entry by the average


conventional yield for that entry, the relative yield of organic agriculture was determined separately for each data entry.

Thus the result showed that organic yields of individual crops are on average 80 percent of conventional yields. The result proved that the organic conventional yield gap increases as conventional yields increase.

2.5 Farm Size and Productivity

One of the earliest attempts to study the relationship between farm size and productivity was published in an article by A.K. Sen (1962)\(^67\), where he stated that large, productivity per acre decreased with increase in farm size. Based on size class data; the inverse relationship was derived. However Sen himself was aware of the limitation of his study as he was using only the aggregated data. Sen (1964)\(^68\) gave three alternative lines of explanation for this phenomenon, (i) technique-based, (ii) labour-based, and (iii) fertility-based.

Mazumdar (1965)\(^69\), Hanumantha Rao (1966)\(^70\), and Khusro (1968)\(^71\), in the Indian agriculture proved the inverse relationship between farm size and productivity phenomenon where its statistical validity was established too. However, about the statistical validity of the ‘inverse relation’, some doubts were expressed by A.P. Rao (1967)\(^72\). He based on the analysis of disaggregated data relating to individual holdings and came up with results contradicting the hypothesis that yield per acre falls as farm size increases.

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Rudra (1968)\textsuperscript{73} strengthened this doubt by an analysis of individual holding in 20 villages. In the next study, he worked with a size-group data Rudra (1968b)\textsuperscript{74} and challenged the validity of generalising the inverse relation for the whole of India. Krishna Bharadwaj (1974)\textsuperscript{75} did an investigation on the relationship between productivity and size of farm using the aggregated data relating to individual districts for the period between 1954 and 1957, and found that an inverse relationship existed for majority of the cases.

Chadha (1978)\textsuperscript{76} studied the farm level data for three agro-climatic regions in the Punjab during the year 1969-70. And found that the inverse relationship had ceased to hold in the more dynamic zones. Rudra and Sen (1980)\textsuperscript{77} attempted to review the main findings both analytically as well as empirically and concluded there was a diversity of Indian agriculture with regard to the relationship between size and productivity. It was found that the negative relation could exist in certain parts of the country at certain times although not everywhere and every time. It may only hold in certain ranges even when the inverse relationship existed, and in a lot of cases it was found only for small size classes.

Carter (1984)\textsuperscript{78} took data from farm management surveys in the Indian state of Haryana and tried in his studies to differentiate between the alternative explanations of the inverse farm-size productivity relationship. It concluded that the inverse relationship was not an indication of partially resulting from sample selection which was based on farmer literacy, nor the misidentification of village effects. The analysis in fact favoured the term “the mode of production” explanation for the inverse relationship.

\textsuperscript{73} Ashok Rudra, “Farm Size and Yield per Acre”, \textit{Economic and Political Weekly}, July, Special Number, 1968a.

\textsuperscript{74} Ashok Rudra, “More Returns to Scale in Indian Agriculture”, \textit{Economic and Political Weekly}, Review of Agriculture, October 26, 1968b.


Chattopadhyay and Sengupta (1997)\textsuperscript{79}, through the farm level disaggregated data for West Bengal during 1989-90; they made a suggestion that the inverse relation between farm size and productivity became stronger in the agriculturally developed regions of West Bengal in comparison to the relatively less developed regions. So, this was possibly caused due to the effects of green revolution on smaller size farms.

Fan and Chan-Kang (2005)\textsuperscript{80}, has stated that small farms characterize agriculture in Asia and that these small-scale farmers play an essential role for food security and poverty alleviation. This research has also empirically observed that the small farms present higher land productivity than the large farms, and it has also revealed that a positive relationship exists between farm size and labor productivity. So in order to help these small farms prosper under increasing globalization, the research has suggested that the governments have to change the “business as usual” attitude and has to initiated innovative land reform, which is crucial to secure property rights to farmers and increase their farm size. The authors have also suggested that by promoting diversification in the production of high-value commodities, it can also play a significant role in raising the small-holders' income.

Even though a number of studies favoured the inverse relationship, some studies revealed that inverse relationship has disappeared in small regions of India (Bhalla and Roy, 1988\textsuperscript{81}; Newell, 1997\textsuperscript{82}). So, according to their research, the causes of inverse relationship might be the regional variations in underlying land quality, moreover they concluded that the stylized fact of an IR between farm size and output could have been in larger part due to the exclusion of soil quality variables from the calculated equations.


Cornia (1985\textsuperscript{83}) had also studied the relationship between factor inputs, yields, and labour productivity for farms of different sizes in 15 developing countries. The results revealed a positive relationship between farm size and productivity in Bangladesh, Peru and Thailand. Deolalikar (1981\textsuperscript{84}) also observed that the inverse relationship could be rejected at a higher level of agricultural technology.

Bhandari (2006)\textsuperscript{85}, through a study proved a positive relationship between land inequality and productivity, here he rejected the argument that small farms appeared to be more efficient than large farms. In Nepal the overall progress of land reform in relation to productivity and poverty reduction has been well summarized. Nonetheless, this study mainly centered on the districts of the southern plain area (i.e. Terai), where the yield was believed to be higher since it had a better soil quality and regular irrigation facility. At a macro level data a simple bivariate regression was used between the Gini index of each district and land productivity. Without considering any other crops or land quality in the model, this finding was solely based on rice yield.

Chand and others (2011)\textsuperscript{86} came to a conclusion that in their study small holders do not lag behind other farm size categories in adoption of better technologies and use of fertilizer and irrigation. In fact the marginal and small holders made better use of inputs and it was found that the crop intensity was in the highest in marginal holdings and declined with the increase in farm size. In the recent years the inverse relationship between farm size and productivity based on the aggregate of all crops has been well-defined. In Asian countries like India and China various theories supporting the disadvantages of marginal and small farmers and economic benefits of large farmers were slowly inoperative. The productivity and growth of Indian agriculture would be adversely


\textsuperscript{84} A. B. Deolalikar, “The Inverse Relationship between Productivity and Farm Size: A Test Using Regional Data from India”, \textit{American Journal of Agricultural Economics}, Vol. 63, No. 1, 1981, pp. 275-279.


affected if any move is made towards increasing farm size on considerations like non-viability of smallholders. This research has found that while the small farms in India are superior in terms of production performance, it is weak in terms of generating sufficient income and sustaining livelihood. Despite high productivity, small holdings below 0.8 ha do not generate adequate income to keep a farm family out of poverty. Thus this research suggested that serious steps must be taken to create employment avenues for small holders outside agriculture, but within the countryside so that the labor force in small farms gets work and income from rural non-farm activities without leaving the farms.

Thus, to sum up the literatures reviewed in this chapter clearly indicate that agriculture has developed remarkably during these past few decades with the advancement of technology and commercial farming. The review of cost of cultivation shows that there is a substantial increase in the cost of cultivation due to the use of modern inputs. Several comparative works on organic farming and inorganic farming have also been reviewed, but very few from the economic point of view were found. However, most of the studies were in favour of organic farming. They also exposed the potential of organic methods for cultivating healthy products, which can also generate better returns than the inorganic method of farming. An inspection of the works on yield gap also showed that its occurrence is the outcome of environmental constraints between the experimental station and farms. Whereas, biological and socio-economic constraints were responsible for the gap between potential and average yield in the farms. Studies on farm size and productivity showed that several economists have put their views that the inverse relationship was valid only for traditional agriculture. As a result, small farms in most developing countries were perceived as more efficient than large farms before the 1980s. But, rapid technological changes and the expansion of commercial farming have changed the whole assumption towards small farming’s efficiencies. Thus, as the agricultural sector has moved towards modernization through the adoption of more capital intensive technology, the inverse relationship has diminished.