AN ECONOMIC ANALYSIS OF ORGANIC AND INORGANIC RICE FARMING IN DIMAPUR DISTRICT, NAGALAND – A CASE STUDY

A dissertation submitted to the Pondicherry University in partial fulfilment of the requirement for the Degree of

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Submitted by

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DECLARATION

I hereby declare that the work embodied in this dissertation entitled **"An Economic Analysis of Organic and Inorganic Rice Farming in Dimapur District, Nagaland – A Case Study"** submitted to the Pondicherry University in partial requirement for the award of Degree of Doctor of Philosophy in Economics, is done by me under the guidance and supervision of **Dr. V. Nirmala.** No part of this thesis has previously formed the basis for the award of any Degree, Diploma, Fellowship or other similar titles of recognition.

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CHAPTER – I

INTRODUCTION

Agriculture has been the fundamental source of survival for man for thousands of years. Even today it has been a source of living to more than half of the world's population. The problem of ass hunger can be overcome only by countries, which can carry the burden of the growing population with better and more production. During the pre-independence period, Indian agriculture was usually called as a gamble with monsoons because of the existence of a great deal of insecurity about crop forecast as the monsoons played a very crucial role in determining the agricultural productivity and its failures would lead in well-known famine and misery. However Indian agriculture has been doing a very extraordinary improvement and is therefore now more flexible to the ill effects of the monsoon, although the country's population has been increasing more than double.

1.1 Sustainable Agriculture and Organic Farming

With the non-stop increase in population including both human and animal along with the decreasing availability of land and water, and other related negative effects on environment has led to lots of unintentional developments, which has resulted in the ruin of the natural resources. The reduction and ruin of the natural resources have not only led to the down fall of productivity, but have also caused a number of other ecological problems. The desire to produce more has only added more troubles causing un-sustainability of the agricultural production system throughout the world. Scarcity of land and water resources, with the increasing population, has resulted to the switching of the land which were used for agricultural purposes to other uses, and the never-ending problems of hunger and starvation in different parts of the world has seriously attracted the world's attention for problems related to sustainability in the agricultural production systems.

In the Indian context, with greater part of the land being ruined, the country has a very little expectation of sustaining even the present crop yield rates in the years to come. The further growth in productivity should be fully based on a improved usage of water and agri-chemicals, and better use of organic manures, indigenous pest control and renewable sources of energy. Therefore, the biggest confront will be to produce more food the people with only few available land which has higher demand of water and other inputs to feed the hunger. The reasons which were responsible for the advancement of green revolution have now become the topic of criticism for us. However, there is a way to solve the problem through usage of inputs like organic manure and bio-fertilizers. And thus organic farming plays the key role for agricultural development.

Sustainable agriculture in the simplest way is defined as the practice of agriculture, which is economically, environmentally and socially feasible. The terms sustainable agriculture and organic farming are very often used as different words with the same meaning. However, they are both entirely different concepts though some of the attributes may be similar. For example, both are recyclable and resource preserving. According to organic farming there should be a total ban on the use of synthetic chemicals and does not forever guarantees economic feasibility and sustainability. The Department of Commerce, Ministry of Commerce and Industry, Government of India has started a National Programme for Organic Production (NPOP), in order satisfy the greater demand of productions through organic farming.[1].

The concept of organic agriculture has been defined differently by different researchers. To majority, it indicates simply the use of organic manures and indigenous plant protection methods without the usage of synthetic fertilizers and pesticides. It is explained by others as farming which includes the use of fertilizers and organic manures together along with chemicals and natural inputs for plant protection. IFOAM (International Federation of Organic Agriculture Movements)[2] explains the main goal of organic farming as ‘Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.’ According to the United States Department of

[1] “National Programme for Organic Production, Indian Organic”, Department of Commerce, Ministry of Commerce and Industry, New Delhi, September 2005, pp. 2-5, http://apeda.gov.in/apedawebsite/organic/ORGANIC_CONTENTS_/English_Organic_Sept05.pdf, Accessed on 1st may 2013

[2]. http://www.ifoam.org/growing_organic/definitions/doa/index.html., Accessed on June 2nd 2013.

Agriculture (USDA) National Organic Standards Board (NOSB) definition, April 1995, 'Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony'[3]. 'Organic farming is a form of agriculture that relies on techniques such as crop rotation, green manure, compost and biological pest control. Organic farming uses fertilizers and pesticides but excludes or strictly limits the use of manufactured (synthetic) fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators such as hormones, livestock antibiotics, food additives, genetically modified organisms, human sewage sludge, and nano materials'[4]. 'Organic agriculture is a well defined method of production that minimizes the use of costly synthetic fertilizers, pesticides and herbicides'[5].

Market for organic products has been growing since 1990, which has reached $55 billion in 2009 according to Organic Monitor (www.organicmonitor.com). And this demand has lead to a parallel increase in the organically cultivated farms which has developed during the years 2001-2011 at a rate of 8.9 percent annually[6]. According to 2014 Annual Report of IFOAM, about 170 countries has reported organic farming activities compared to 86 countries in the year 2000. India has the largest number of organic producers in the world[7].

[3] Mary V. Gold, "Organic Production/Organic Food: Information Access Tools", Alternative Farming Systems Information Center, United States Department of Agriculture (USDA), National Agricultural Library, United States of America, June 2007, p. 224, Accessed on 2nd June 2013.

[4] John Paull, "Nanomaterials in Food and Agriculture: The Big Issue of Small Matter for Organic Food and Farming", Proceedings of the Third Scientific Conference of ISOFAR (International Society of Organic Agriculture Research), Namyangju, Korea, 28 September - 1 October 2011, pp. 96-99, Accessed on 2nd June 2013.

[5] Muhammad Iftikhar ul Husnain and Muhammad Khan, "The Public and Private Benefits from Organic Farming in Pakistan", Economics and The Environment, Working Paper No. 99, COMSATS Institute of Information Technology, Lahore, Pakistan, September 2015, p. 1.

[6] John Paull, "The Uptake of Organic Agriculture: A Decade of Worldwide Development", *Journal of Social and Development Sciences*, Vol. 2, No. 3, 2011, pp. 111-120 Accessed on 2nd June 2013.

[7] "Consolidated Annual Report of IFOAM – Organic International", IFOAM Publications, Germany, 2014, p. 2, Accessed on 22 May 2016.

1.2 Agriculture in Less Developed and Developed Countries

Majority of the world's poor people live in rural areas (i.e., about 75%), and farming is the main source of livelihood for most of them. The most common problem faced in these areas that comes in the way of agricultural advancement are problems related to the access of better technologies, huge institutional weaknesses, and problems linked with the organization and management of research, extension and education systems thus many countries and agricultural systems are still caught up in the state of underdevelopment and faces all the major obstacles to the use of knowledge and modernization for growth.

1.2.1 Agriculture in Developing Countries

For developing countries agriculture still plays a very important role and Gross Domestic Product (GDP) growth from agriculture has observed to have benefited the poor people's incomes two to four times more than GDP growth in rest of the sectors of economy[8]. In Less Developed Countries (LDC's) agriculture is explained as a subsistence agriculture, the main purpose of which is to supply food for farmer's family's domestic consumption. This type of agriculture is mostly practiced due to the absence of money and technology in these LDC's. And the other reason is due to the environmental condition that many LDC's exist in[9].

Shifting cultivation is one of the earliest types of cultivation that subsistence farmers used in world's most humid, low latitude climate regions and excessive rainfall. This type of cultivation is practised mostly in the Amazon area of South America, Central and West Africa, and Southeast Asia including Indochina, Indonesia, and New Guinea. [10]It has two characteristic areas, first is the slash-and-burn agriculture where the farmers would clear land for cultivating by cutting down all flora and burning the remains. Then the farmers will cultivate on the cleared land

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[8] Asenso-Okyere, Kwadwo Davis, Kristin Aredo and Dejene, "Advancing Agriculture in Developing Countries through Knowledge and Innovation", Conference Number, International Food Policy Research Institute, Washington, D. C., United States of America, November 2008, pp. 1-32, http://dx.doi.org/10.2499/0896297802, Accessed on 07/06/2012.

[9] Franz Heidhues and Michael Bruntrup, "Studies on the Agriculture and Food Sector in Central and Eastern Europe", (Ed.) by Institute of Agricultural Development in Central and Eastern Europe, Vol. 22, Institute of Agrarent Wicklung in Mittelund Osteuropa (IAMO), Germany, 2003, pp. 1-27, Accessed on 07/06/2013.

[10] Balaram Dash, "Shifting Cultivation among the Tribes of Orissa", *Orissa Review*, Vol. 5, No. 6, July 2006, pp. 76-84, www.orissa.gov.in, Accessed on 07/06/2013.

for few years and then which will be moved on to another land to cut down all flora in order to start cultivating. The reason for the movement is to let the vegetation grow back on the land so that the soil can be restored. The burning remains are used as the only fertilizer. Rice, maize and manioc are some of the major crops of shifting cultivation.

Pastoral nomadism is the next important practice of subsistence farmers in less developed countries, and this type of farming is based on the herding of domesticated animals. Milk is provided by animals and their skins and hair are used for purposes like clothing and tents. Thus, it is simply a way of surviving on land that has too little rain for agricultural activities. In India, this kind of farming is mostly common in the dry lands of Western India (i.e., Thar Desert) and on the Deccan Plateau, and in the mountainous regions of Northern India (i.e., the Himalayas) [11].

Finally, intensive subsistence agriculture is the third type of subsistence farming, here intensive means that the farmers must work more deeply to survive on a small plot of land. Since the ratio of farmers to cultivable land is very high in heavily populated areas, therefore farmers must cultivate on every bit of land. In the wet region of Asia, wet rice is the most popular crop grown and here rice is planted on dry land in a nursery then later the seedlings are moved to a flooded field in order to encourage growth. Crop rotation is another type farming which is practiced mostly in parts of Asia where wet rice cannot grow, here varieties of crops are planted each time in the same plot of land, which helps the farmers in keeping the soil from exhausting. Thus, in less developed countries subsistence agriculture is the only way for the families to survive. In less developed countries agriculture is only for survival and for the security of their own families.

1.2.2 Agriculture in Developed Countries

Agriculture system in more developed countries is relatively different from the less developed countries and can be describe as the commercial agriculture. Commercial agriculture is type of agriculture which aims mainly to produce products for sale from the farm and such farm is supported considerably by the income earned

[11] Vijay Paul Sharma, Ilse Kohler Rollefson and John Morton, "Pastoralism in India: A Scoping Study", Centre for Management in Agriculture Indian Institute of Management (IIM), Ahmadabad, Gujarat, 2003, pp. 23–28, Accessed on 25/ 11/13.

from cultivation and the agricultural business. This type of agricultural sector plays a crucial role in the state's economy. Dependence on technological and scientific advancements is an important distinguishing characteristic of commercial agriculture. Thus, a very small number of farmers in a developed country can provide food to many since they depend on technology rather than human labour or animals. Another important feature of commercial agriculture is that most of the farmers belong to either large or average farm size and that the main motive of the farmers behind the agricultural activity is to earn huge profit from the farm rather than to feed their own families. Signing big contracts with well known food companies to sell their crops and livestock in huge number for high prices is their main motive. And finally commercial farming's incorporation with other businesses is the final important character. Thus it is an agribusiness, because the farm is not an isolated activity but is incorporated into a large food production industry.

There are sharp divisions between developed and developing countries and there has been urgency for the latter to develop their indigenous supply of food to meet the needs of their rapidly expanding population[12].

1.3 Indian Agriculture

Indian agriculture during ancient period was mainly based on organic farming and the whole agriculture system was based on organic inputs, where the fertilizers, pesticides were from plant and animal remains. Small and marginal farmers feeding their families and local village communities by producing foods was the main feature of traditional farming system in India. The farmers deciding on the types of crops to be produced based on climatic and soil conditions played a major role in decentralizing the farming system in India. Farming practices such as the shifting cultivation, conservation, use of animal manures and farm wastes, and legumes into crop rotations helped in achieving pest control and improving soil health.

1.3.1 Indian Agriculture Development: Before and After the Green Revolution

During 1950's and 1960's, with the increasing population of India and the natural calamities, India had to suffer a severe food scarcity. So to deal with the

[12] J. Ashton and H.C. Pereira, "Agriculture in Developed Countries: Competition for Resources", *Biological Sciences,* Vol. 267, No. 882, December 6, 1973, pp. 13-22, Accessed on 07/02/14.

problem, the government had to increase the production of food in the country, for which several efforts were made. The New Agricultural Strategy (NAS) was initiated in 1966, which formulated policies to utilise and promote high-yielding varieties of food grains in all districts selected under the Intensive Agricultural District Programme (IADP) and Intensive Agricultural Area Programme (IAAP) schemes. The NAS also came to be known as the High-Yielding Varieties Programme (HYVP)[13].

After World War II, green revolution had lead to the advancement of commercial agriculture in the developed countries. It mainly aimed at improving the land productivity through scientific technology. Under HYVP, varietal improvement helped packing into the seed an ability to yield more for a given situation. This potential is best expressed and realised through an appropriate attendant crop management practices more relevant and calls for simultaneously devoting research efforts for its improvement. The crop management practices are closely linked with the land situation and water availability conditions. In India, the first dwarf variety of wheat was introduced by the scientists with the help of Dr. Norman Borlaug at the Indian Agricultural Research Institute (IARI), New Delhi, in 1962-63. Since then a number of rice research centres have been established in India.

The advancement of Indian agriculture during the last 40 years can be explained under three areas, First is the advancement in developing the research and educational infrastructure, which was required for developing and testing technologies which would be appropriate for different agro-ecological regions, next was a sensibly capable input production system for the production and distribution of seeds, fertilizers and other inputs. Finally he third step to develop the policies necessary for inspiring higher productivity by small farmers and higher consumption by the poor rural and urban people. Thus, the agricultural system was completely developed with the introduction of high-yielding varieties which resulted to a huge number of pest

[13] A.N. Sadhu and R.K. Mahajan, "Technological Change and Agricultural Growth in India", *Technological Change and Agricultural Development in India,* Himalaya Publishing House, Delhi, 1985, pp. 3-9.

issues of economic significance. And increased higher fertilizers usage, irrigation and adoption of high-yielding varieties caused the rebirth of pest problems[14].

But unfortunately, green revolution had a negative impact on farmers with small farm size, as they found themselves trapped in the cycle of high interest rates on seeds, fertilizers and pesticides which they had to buy on credit[15]. In order to solve the problem of uneven geographical distribution the researchers tried to cooperate with the environment by using traditional methods of crop rotation and the cultivation of various varieties of crops. However, they introduced advanced crops that would be adapted to any inappropriate conditions as long as they are properly irrigated and provided expensive inputs of fertilizers and pesticides which resulted in inequalities between the rich farmers and the poor farmers[16]. Thus, due to the evil effects of green revolution, many farmers committed suicide, making the number of suicide cases during 1966 as 37,848 farmers the rate of 7.6 percent, which later on has increased to 10.8 percent by 2000[17].

1.3.2 Indian Agriculture: The Present Scenario[18]

Agriculture has been an important sector of the Indian economy, and about 48 percent of India's population is dependent on agriculture, however it accounted for 17.6 percent of the total nations' GDP in 2014-15. The Central Survey Organisation had estimated a positive growth rate of 0.2 percent for agriculture in India during 2014-15. It has also been recorded that the total food grain production in the country stood at 251.1 Metric Tonnes (MT) in 2014-15, showing a decline of 13.9 MT from 2013-14. The area under cultivation of food grains has remain stagnant, at 120.4 million ha, for over four and a half decades, however, the area under cultivation of

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[14] Amarnath Tripathi and A.R. Prasad, "Agricultural Development in India since Independence: A Study on Progress, Performance, and Determinants", *Journal of Emerging Knowledge on Emerging Markets,* Vol. 1, No. 1, November 2009, pp. 63-92, http://*www.icainstitute.org*, Accessed on 27/03/13.

[15] Kathryn Sebby, The Green Revolution of the 1960's and Its Impact on Small Farmers in India, Environmental Studies Undergraduate Student Thesis, Paper 10, University of Nebraska, Lincoln, United States of America, January 2010, p.10, http://digitalcommons.unl.edu/envstudtheses. Accessed on 21/03/13.

[16] Jason Overdorf, "The Green Devolution: India's Population is Growing Faster than Farm Output, Threatening One of its Most Prized Achievements," *Newsweek,* 28 August 2006, Accessed on 13/12/13.

[17] S. Mishra, "Suicide Mortality Rates across States of India, 1975-2001: A Statistical Note," *Economic and Political Weekly*, Vol. 41, No. 16, 2006, pp. 1566-1569, Accessed on 15/12/2013.

[18] National Bank for Agriculture and Rural Development (NABARD), *Annual Report 2014-15*, NABARD Publications, Mumbai, 22 June 2015, pp. 12-28, Accessed on 22/05/2016.

rice has increased from 37.0 million ha to 43.9 million ha, from 1968-69 to 2013-14.

India has proved as an important agri-exporter in crops like oil-meals, cotton, pepper rice, and sugar, as well as meat. India's agricultural exports were valued at US$47 billion in 2013, and its share in total world exports stood at 2.7 percent. Among the top exporters of agricultural products, India was also one of the countries showing the greatest increase in agricultural exports of about 11 percent.

1.3.3 Agriculture in North-Eastern India[19]

In India the North East part constitutes of the eight states they are Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, surrounded by the hills and the Brahmaputra River between its north and south. To its north lies Arunachal Pradesh and towards the North West bordering of China and Bhutan lays Sikkim. At the southwest and east is the Bangladesh and Myanmar. The heavy Brahmaputra provides its rich alluvial silt beside the banks of the plains of Assam. The tropical rain forest which is rich in flora and fauna, covers from Arunachal Pradesh to Assam. It is a land with rice as the stable food, tea is a trade, handicrafts a key of livelihood and martial arts is an ideal activity of the people.

The North East states are one of the most bio-diversified regions in the world. About 65 per cent on an average which is covered by forest cover is owned by government, and the rest is owned by the village communities, individuals and chiefs. There are three geographical divisions, they are the Shillong Plateau, the North Eastern hill Basin and the Brahmaputra Valley. The identification of economy of North-eastern parts India is mainly due to its rare physical, economic and socio-cultural characteristics. An area of 2.62 lakh sq. km. is covered by the NER of India and accounts for about 7.9 percent of total geographical area of the country.

1.4 Statement of Problem

With the non-stop increase in population including both human and animal along with the decreasing availability of land and water, and other related negative effects on environment has led to lots of unintentional developments, which has resulted in the ruin of the natural resources. The reduction and ruin of the natural resources have not only led to the down fall of productivity, but have also caused a

[19] www.ibef.org, Accessed on 02/02/14.

number of other ecological problems. The desire to produce more has only added more troubles causing un-sustainability of the agricultural production system throughout the world. Scarcity of land and water resources, with the increasing population, has resulted to the switching of the land which were used for agricultural purposes to other uses, and the never-ending problems of hunger and starvation in different parts of the world has seriously attracted the world's attention for problems related to sustainability in the agricultural production systems.

The concept of organic agriculture has been defined differently by different researchers. To majority, it indicates simply the use of organic manures and indigenous plant protection methods without the usage of synthetic fertilizers and pesticides. It is explained by others as farming which includes the use of fertilizers and organic manures together along with chemicals and natural inputs for plant protection.

Very few studies on organic farming from economic perspectives are available so far. This study attempts to fill this gap. It attempts to compare the economics of organic and inorganic rice farming in Nagaland. Besides, it examines whether organic farming benefits the rural farmers as compared to the inorganic farmers by farm size. This study deals with some of the main problems like labour absorption, input and output structure, cost and returns, determinants of yield, yield gap and yield constraints, farm size and productivity, inequalities of income distribution from rice cultivation and farmers' choice of rice cultivation determinants.

According to 2011 census, Dimapur district in Nagaland had 205 villages, and the total number of farming households was 35,662, out of which the total farming population was 1,83,552[20]. Out of these 205 villages in Dimapur district, Suhoi and Kuhuboto villages were chosen for the study as these two villages have both the types of farmers, i.e., a group of farmers still practising the traditional organic farming, and another group practising the modern inorganic farming using hybrid seeds and improved techniques mostly for commercial purpose. Of the sixteen varieties of rice cropped in Nagaland, Ranjit (inorganic) and Naga Local/Special rice (organic) are the two mostly cropped rice varieties by the farmers in the study area. Therefore, the two varieties have been chosen for the comparative study.

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[20] Director Office, *Agriculture Report 2012-13*, Department of Agriculture, Dimapur District, Nagaland, 2013.

With the increase in the use of high yielding varieties and modern technology, input use and cost have also been increasing with the rising yields. A comparative study of the levels of input application and the returns accruing to both rice varieties, as well as to the small and medium farmer groups is warranted to understand the pattern of input use, cost and yield across the rice varieties and farm size.

The rice yield is affected by the cultivation techniques, which tends to be different for different rice varieties and farm size. Hence, an understanding of the factors that contribute to increased or decreased output of both the rice varieties and farm sizes becomes mandatory.

It has been found that the rice yield achieved under field conditions generally fails to approach its experimental station yield potential (Mukherji[21] and Kalirajan[22]). It has also been found that gap exists between the maximum yield attained at farm level and the average yield achieved by farmers (Flinn and Ali[23]). This leads to the necessity of studying the magnitude of yield gap that exists between the maximum and average yield for each rice variety in the study area. The identification of the bio-physical and socio-economic factors that restricts farmers from achieving the potential yield at farm level is also deemed necessary.

There is a significant divergence in views relating to the relationship between farm size and farm efficiency. Several economists have opined that inverse relationship remains valid only for traditional agriculture. With the rapid technological changes and expansion of commercial farming, the inverse relationship has disappeared. Hence, a verification of the nature of relationship between farm size and farm efficiency in the study area is important.

The benefits of the advancement of technology and commercial farming have not been shared equally by farmers within and between varieties and farm size. Therefore, in order to understand the impact of cultivation of both the rice varieties on

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[21] D. K. Mukherji, *Gap Analysis: An Effective Production Increase Concept in Rice,* Summary of Lecture delivered at the State Level Training Meeting on Rice held at Purila, Department of Agriculture, West Bengal, India, July, 1977.

[22] K. Kalirajan, "The Contribution of Location Specific Research to Agricultural Productivity", *Indian Journal of Agricultural Economics,* Vol. 35, No. 4, July-September 1980, pp. 8-16.

[23] J. C. Flinn and Mubarak Ali, "Technical Efficiency in Basmati Rice Production", *Pakistan Journal of Applied Economics ,* Vol. 1, No. 2, October 1966, pp. 1-22.

the income distribution of the farmers, it is essential to study their income distribution.

With the absence of studies on organic rice cultivation from economic perspective, this study also attempt to examine the factors which determine the decision of farmers regarding their choice of rice cultivation method, besides exploring whether environmental concern influences organic method of rice cultivations. It also examines the attitude, concern and actions of farmers across rice variety and farm size towards environment.

1.5 Objectives of the Study

This study examines the following objectives:

1. to study the cost and returns structure of organic and inorganic rice cultivation by varieties across farm size in the study area;
2. to investigate the determinants of yield of the two rice varieties by farm size;
3. to identify the yield gap and its constraints with regard to the two rice varieties across farm size;
4. to analyse the farm size-productivity relationship of the two rice varieties; and
5. to examine inequalities in net income distribution of the farmers cultivating the two rice varieties.

1.6 Data and Methodology of the Study

This study is based on both the secondary and primary data. Secondary data is drawn from Statistical Abstract of Nagaland (various issues), Indiastat.com, Reports of Agriculture District office, and Taluk Village Development Board office, Dimapur Nagaland. The primary data is collected using pre-tested schedule from a total sample of 350 farmers cultivating rice during November-December 2013. A census method has been adopted to collect data from all 100 organic farmers cultivating Nagaland Special rice in Suhoi and Kuhuboto villages of Dimapur district, Nagaland. In addition, a random sample of 250 inorganic farmers cultivating Ranjit rice variety has been selected from the two villages, as majority of the inorganic farmers cultivate Ranjit rice variety. To examine the farm-size effects, the data collected has been divided into two groups of small farmers (with land ownership of less than 4.95 acres) and the medium farmers (with land ownership 4.95 to 12.36 acres). The small and medium farmers alone have been considered by the study, as in the selected villages, there are hardly any farmers.

The objectives of the study has been analysed using simple averages, ratios, percentages, correlation matrix, log linear production function, simple regressions, Chow test[24], Garrett Ranking Technique, Lorenz curve Gini index, Robin Hood Index (another measure of inequality) and F-test,. The following log linear production function has been fitted to study the determinants of rice yield:-

$$\log YIELD_i = \beta_0 + \beta_1 \log LABOR + \beta_2 \log FRTZR + \beta_3 \log PESTD + \beta_4 \log KFLOW + \beta_5 \log IRRIG + \beta_6 \log NTRTN + \beta_7 \log FRMSZ + \mu$$

where,

$YIELD_i$ = yield/ output per acre in kg. of the two rice variety by farm size i (where, i = organic and inorganic small, medium and total rice farmers);

LABOR = total labour mandays employed per acre;

FRTZR = chemical fertilizer/ organic manure per acre in kg.;

PESTD = pesticides per acre in kg.;

KFLOW= capital flows per acre in Rs.;

IRRIG = irrigation cost per acre in Rs.;

NTRTN = net return per acre in Rs.;

FRMSZ = farm size dummy (where, 1= small and 0= medium); and

μ = error term.

The regression is estimated using ordinary least squares (OLS) principle. The expected effects of all inputs are positive on yield. Whereas, increase in farm size is expected to have negative effect due to the emergence of diseconomies of scale.

Further, Chow test (1960) was estimated to examine if structural difference exists between organic as well as inorganic rice farmers, and small and medium farmers. The formula used is:-

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[24] Gregory C. Chow, "Tests of Equality between Sets of Coefficients in Two Linear Regressions", *Econometrica,* Vol. 28, No. 3, July 1960, pp. 591-605.

$$F^* = \frac{€e^2 - (€e_1^2 + €e_2^2)/K}{(€e_1^2 + €e_2^2)/n_1+n_2 - 2K}$$

where, K = number of parameters, including the intercept term; $€e^2$ = unexplained sum of squares for total farmers; $€e_1^2$ = unexplained sum of squares for organic small farmer group; $€e_2^2$ = unexplained sum of squares for inorganic medium farmer group; and n_1+n_2 = total number of observations.

The relationship between the farm-size and productivity has been examined in terms of land, labor, average variable cost and average total cost. For the analysis, the given model has been estimated in log form:-

$$\ln DEPVA_i = \alpha + \beta \ln ACRES + \varepsilon$$

where, ACRES is the total cultivated land; $DEPVA_i$ represents the dependent variables, where, i = 1,...,4: 1 = yield per acre in Kg.; 2 = labour mandays per acre; 3 = average variable cost per acre in Rs.; 4 = average total cost per acre in Rs.; and ε represents the error term.

The yield gap for both the rice varieties has been calculated in two different ways: first, by estimating the difference between the experimental station yield to the potential farm level yield called the yield gap-I; and the second, by finding the difference between potential farm yield and actual yield called the yield gap-II (Nirmala, 1992)[38].

Garrett ranking technique (1969)[25] has been used to identify the main constraints to potential yield in the two villages. The respondents ranked the constraints faced by them according to their priority. Then the order of merit assigned to each constraint ranked by the respondent was converted into ranks by using the following formula:

$$\text{Per Cent Position} = \frac{100\,(R_{ij} - 0.5)}{N_j}$$

[25] Henry E. Garrett and R. S. Woodworth, *Statistics in Psychology and Education,* Vakils, Feffer and Simons Private Ltd., Bombay, 1969, p. 329.

where, R_{ij} = rank given by the j^{th} individual for the i^{th} factor; and N_j = number of factors ranked by the j^{th} individual.

The percent position of the ranks obtained are converted into scores using Garrett's ranking table. These scores of all farmers are then added up and divided by the number of farmers who have responded. This gives the mean scores for each reason, which are arranged in descending order and ranks given.

Lorenz curve, Gini ratio and Robin Hood Index have been used to examine the impact of the two rice varieties and farm size on their income distribution. F – test is used to examine whether they are significantly different.

The following Ordinary Least Squares (OLS) regression has been fitted to study the determinants of the farmers' choice of rice cultivation method:-

$$PRDCH = \alpha_0 + \alpha_1 logEDUFR + \alpha_2 logEXPFR + \alpha_3 logLNDON + \alpha_4 logPMKTS + \alpha_5 logNTRTN + \alpha_6 SEXFR + \alpha_7 MRTLS + \alpha_8 ATTDF + \mu$$

where,

PRDCH = farmers' production method choice, taking value zero for inorganic farming, and one for organic;

EDUFR = farmers' education in years;

EXPFR = farmers' rice cultivation experience in years;

LNDON = farmers' land ownership in acres;

PMKTS = percentage of marketable surplus out of the total output produced;

NTRTN = net returns per acre in Rs.,

SEXFR = farmers' sex, taking value one for female and zero for others;

MRTLS = farmers' marital status, taking value one for married and zero for others;

ATTDF = farmers' attitude towards use of agri-chemicals in rice cultivation;

FRMSZ = farm size in acres; and

μ = error term.

1.7 Scope of the Study

A comparison of organic and inorganic rice cultivation by farm size in Dimapur district, Nagaland, will help to understand the economics of cultivating them across varieties/ farm size, based on the cost and return structure of farming activities for both the rice varieties by farm size.

An analysis of yield determinants will highlight the important variables that determine yield by rice varieties and farm size. A look into the yield gap between the two rice varieties (Ranjit for inorganic and Naga Special for organic rice) by farm size will indicate which variety yields relatively more output, and which farmers by farm size produce larger output. Further, a survey of the problems leading to the yield gap will illustrate the reasons for the yield gap.

An analysis of farm size and productivity efficiency relationship with respect to land and labor productivity, and total and variable costs for the two rice varieties will provide information on their effects as farm size increases in the study area.

A study of the inequalities in household income distribution of the farmers cultivating the two rice varieties would demonstrate as to which rice variety cultivation contributes more to narrowing of income variations among the sample households.

Overall, such a study would highlight the overall economic benefits of cultivating the organic and inorganic rice varieties across farm size. This would be useful to policy makers for formulation of suitable policy measures to encourage the respective farmers in cultivating the respective rice varieties more efficiently and narrowing the yield gap. It would also provide significant information to researchers on the issue and encourage further research on it.

1.8 Limitations of the Study

This study is based on data limited to only one kharif season rice cultivation of the year 2013. A limited sample size of 350 rice cultivating farmers has been studied and has also been confined to only two rice varieties, viz., Naga special rice (organic) and Ranjit rice variety (inorganic). Further, the study has been conducted at a micro level in two villages Suhoi and Kuhuboto, in Dimapur district, Nagaland. Therefore, the findings cannot be generalised for the whole country and for all the crops, but is applicable only to regions with similar geographic and climatic conditions.

1.9 Chapter Scheme

The chapter scheme of the study is as follows:

Chapter – I gives a brief introduction, along with statement of problem, objectives, data and methodology, scope and limitations of the study.

Chapter – II reviews some of the earlier studies relating to the present research.

Chapter – III briefly outlines the profile of the study area.

Chapter – IV presents input and output structure, labor absorption for different farm activities, and cost and return structure for both organic and inorganic rice varieties by farm size.

Chapter – V examines the determinants of yield, the yield gap between the two rice varieties and farm size, yield gap constraints, and the relationship between farm size and productivity.

Chapter – VI analyses the household income distribution of the farmers cultivating the two rice varieties, determinants of choice of rice cultivation method and farmers' attitude towards environmental issues.

Chapter – VII summarizes the major findings and gives the policy implications of the study.

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. N 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

[1]K. William Easter, Martin E. Abel and George Norton, "Regional Differences in Agricultural Productivity in Selected Areas of India", *American Journal of Agricultural Economics*, Vol. 59, No. 2, May 1977, pp. 257 – 265.

[2] Joan P. Mencher and K. Saradamoni, "Muddy Feet, Dirty Hands: Rice Production and Female Agricultural Labour", *Economic and Political Weekly*, Vol. 17, No. 52, December 25, 1982, pp. A149-A153, Accessed on 19/04/2012 00:40.

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,

[3] Aranya Dutta, The Growth Rates of Agricultural Output in the North Eastern Region, Ph.D Thesis, Department of Economics, North Eastern Hill University, Shillong, March 1983.

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., Mahaijan 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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[4] Banti Gogoi Howbora, A Comparative Study of Tribal and Non-Tribal Agricultural Practices and its Effects on Agricultural Development: A Case Study of Lakhimpur Block, M.Phil Thesis, Department of Economics, North Eastern Hill University, Shillong, 1987.

[5] T. Buragohain, Agricultural Development: A Study of Inter-Crop and Inter-Regional Variations in North-East India, M.Phil Thesis, Department of Economics, North Eastern Hill University, Shillong, May 1988.

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) [6] 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)[7] reviewed earlier literatures available on upland rice, mostly cultivated in Asia, Africa and Latin America. The productivity of upland rice was

[6] V. Nirmala, *Economic Analysis of Rice Cultivation: A Study of Tamil Nadu*, Concept Publishing Company, New Delhi, 1992.

[7] N.K. Fageria and V.C. Baligar, "Upland Rice and Allelopathy", *Communications in Soil Science and Plant Analysis*, Vol. 34, No. 9-10, June 2003, pp. 1311-1329, Accessed on 10/05/2013.

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)[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.

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[8] Aldas Janaiah and Mahabub Hossain, "Can Hybrid Rice Technology Help Productivity Growth in Asian Tropic: Farmers' Experiences", *Economic and Political Weekly*, Vol. 38, No. 25, June 21-27, 2003, pp. 2492-2501, Accessed on 19/04/2012.

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

[9] K.C. Talukdar and B.C. Beka, "Cultivation of Summer Rice in the Flood Plains of Assam: An Assessment of Economic Potential on Marginal and Small Farms", *Agricultural Economics Research Review,* Vol. 18, No. 1, January-June 2005, pp. 21-38, Accessed on 16/09/2013.

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)[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.

[10] Parshuram Samal and Sushil Pandey, "Climatic Risks, Rice Production Losses and Risk Coping Strategies: A Case Study of a Rain-fed Village in Coastal Orissa", *Agricultural Economics Research Review,* Vol. 18, Conference Number, 2005, pp. 61-72, Accessed on 17/09/2013.

Suresh and Reddy (2006) [11], studied the efficiencies of price and technology n 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) [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

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[11] A. Suresh and T.R. Keshava Reddy, "Resource-use Efficiency of Paddy Cultivation in Peechi Command Area of Thrissur District of Kerala: An Economic Analysis", *Agricultural Economics Research Review,* Vol. 19, No. 1, January-June 2006, pp. 159-171, Accessed on 17/09/2013.

[12] B.L. Gajja, Khem Chand and Y.V. Singh, "Impact of Land Irrigability Classes on Crop Productivity in Canal Command Area of Gujarat: An Economic Analysis", *Agricultural Economics Research Review,* Vol. 19, No. 1, January-June 2006, pp. 83-94, Accessed on 16/09/2013.

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 costin 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

[13] Varinderpal Singh, Yadvinder Singh, Bijay Singh, Baldev Singh, Rajeev Kumar Gupta, Jagmohan Singh, Jagadish K. Ladha and Vethaiya Balasubramanian, "Performance of Site-specific Nitrogen Management for Irrigated Transplanted Rice in North-Western India", *Archives of Agronomy and Soil Science*, Vol. 53, No. 5, October 2007, pp. 567-579, Accessed on 20/05/2013.

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 Nha^{-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.

Razzaque and Rafiquzzaman (2007)[14], tried to study possible reasons of yield gap of T. Aman rice (BR-23) between the demonstration plot with Research management and Non-demonstration plot (NDP) with farmer management practices at Barguna during 1999 and 2000.

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

[14] M. A. Razzaque and S. Rafiquzzaman, "Comparative Analysis of T. Aman Rice Cultivation under Different Management Practice in Coastal Area ", *Journal of Agriculture and Rural Development (JARD),* Vol. 5, No. 1, June 2007, pp. 64-69, Accessed on 15/09/2013.

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)[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

[15] K. Senthilkumar, P.S. Bindraban, T.M. Thiyagarajan, N. de Ridder and K.E. Giller, "Modified Rice Cultivation in Tamil Nadu, India: Yield Gains And Farmers' (Lack of) Acceptance", *Agricultural Systems,* Vol. 98, No.. 2, September 2008, pp. 82–94, Accessed on 17/09/2013.

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.

[16] T. A. A. Naing, A. J. Kingsbury, A. Buerkert and M. R. Finckh, "A Survey of Myanmar Rice Production and Constraints", *Journal of Agriculture and Rural Development in the Tropics and Subtropics,* Vol. 109, No. 2, 2008, pp. 151–168, Accessed on 16/09/2-13.

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)[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

[17] Y. Radha, K. Yella Reddy, G. Subba Rao, S. Ramesh Chandra and G. Kishore Babu, "Water-saving Rice Production Technologies in Krishna Western Delta Command of Andhra Pradesh: An Economic Analysis", *Agricultural Economics Research Review,* Vol. 22, Conference Number, 2009, pp. 397-400, Accessed on 17/09/2013.

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

Devi and Ponnarasi (2009)[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

[18] K. Sita Devi and T. Ponnarasi, "An Economic Analysis of Modern Rice Production Technology and its Adoption Behaviour in Tamil Nadu", *Agricultural Economics Research Review,* Vol. 22, No. 1, 2009, pp. 341-347, Accessed on 15/09/2013.

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) [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)[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-

[19] B. C. Barah, "Economic and Ecological Benefits of System of Rice Intensification (SRI) in Tamil Nadu", *Agricultural Economics Research Review,* Vol. 22, No. 2, July-December 2009, pp. 209-214, Accessed on 16/09/2013.

[20] B. Nirmala and P. Muthuraman, "Economic and Constraint Analysis of Rice Cultivation in Kaithal District of Haryana", *Indian Journal of Extension Education,* Vol. 9, No. 1, January 2009, pp. 47-49, Accessed on 17/09/2013.

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

[21] Diana Sarungbam and Y. E. Prasad, "Factors Affecting Adoption of Mono Cropping of Rice in Manipur: A Logistic Approach", *Agricultural Economics Research Review*, Vol. 24, No. 2, July – December 2011, pp. 333 – 337, Accessed on 19/04/2012.

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)[22] 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. Bene t-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 eld 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 remianing 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.

[22] Vijay Pooniya and Yashbir Singh Shivay, "Summer Green Manuring Crops and Zinc Fertilization on Productivity and Economics of Basmati Rice (Oryza Satival)", *Archives of Agronomy and Soil Science*, Vol. 58, No. 6, July 2011, pp. 593-616, Accessed on 20/05/2013.

Geethalakshmi, Velliangiri and others (2011)[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 di erent 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 di erence level.

The results revealed that maximum number of tillers m^{-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)[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 (BAnkei 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

[23] Velliangiri Geethalakshmi, Thanakkan Ramesh, Azhagu Palamuthirsoloi and Lakshmanan, "Agronomic Evaluation of Rice Cultivation Systems for Water and Grain Productivity", *Archives of Agronomy and Soil Science*, Vol. 57, No. 2, April 2011, pp. 159-166, Accessed on 20/05/2013.

[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", *Achives 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,

$P = m/N + 1 \times 100$;

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) b y 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 receive d good yield (2.05–2.9 5t 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. Import ant 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)[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.

[25] Gailyson Yelwa Jamala, Haruna Ezekiel Shehu and Apollos T. Garba, "Evaluation of Factors Influencing Farmers Adoption of Irrigated Rice Production in Fadama Soil of North Eastern Nigeria", *Journal of Development and Agricultural Economics,* Vol. 3, No. 2, February 2011, pp. 75-79, Accessed on 17/09/2013.

Mukherjee and Gupta (2011)[26], 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: 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.

[26] Vivekananda Mukherjee and Gautam Gupta, "Toxicity and Profitability of Rice Cultivation under Waste-Water Irrigation: The Case of the East Calcutta Wetlands", Working Paper No. 62–11, South Asian Network for Development and Environmental Economics (SANDEE), Kathmandu, Nepal, August 2011, pp. 1-16, Accessed on17/09/2013.

Haldar, and others (2012)[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.

[27] Surajit Haldar, Honnaiah and G Govindaraj, "System of Rice Intensification (SRI) Method of Rice Cultivation in West Bengal (India): An Economic Analysis", International Association of Agricultural Economists (IAAE) Conference Paper, Brazil, 18-24 August, 2012, pp. 1-25, Accessed on 15/09/2013.

John and Fielding (2014)[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) [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

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[28] Adam John and Matthew Fielding, "Rice Production Constraints and 'New' Challenges for South Asian Smallholders: Insights into *De Facto* Research Priorities", *Agriculture & Food Security*, Vol. 3, No. 18, 03 December 2014, pp. 2-16.

[29] James C. Hanson, Erik Lichtenberg and Steven E. Peters, "Organic Versus Conventional Grain Production in the Mid-Atlantic: An Economic and Farming System Overview", *American Journal of Alternative Agriculture*, Vol. 12, No. 1, 1997, pp. 2-9, Accessed on 10/04/2013.

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)[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-

[30] Kathleen Delate, Michael Duffy, Craig Chase, Ann Holste, Heather Friedrich and Noreen Wantate, "An Economic Comparison of Organic and Conventional Grain Crops in a Long-term Agro-ecological Research (LTAR) Site in Iowa", *American Journal of Alternative Agriculture*, Vol. 18, No. 2, 2001, pp. 59-69, Accessed on 10/05/2013.

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

[31] Y. V. Singh, B. V. Singh, S. Pabbi and P. K. Singh, "Impact of Organic Farming on Yield and Quality of Basmati Rice and Soil Properties", (Ed.) Indian Agricultural Research Institute, New Delhi, India, March 2007, pp. 1-4, Accessed on 19/04/2012.

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)[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.

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[32] P.B.S. Bhadoria and Y.S. Prakash, "Relative Influence of Organic Manures in Combination with Chemical Fertilizers in Improving Rice Productivity of Lateritic Soil", *Journal of Sustainable Agriculture*, Vol. 23, No. 1, September 2008, pp. 77-87, Accessed on 15/04/2013.

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.

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[33] Carolyn P. Egri, "Attitudes, Backgrounds and Information Preferences of Canadian Organic and Conventional Farmers: Implications for Organic Farming Advocacy and Extension", *Journal of Sustainable Agriculture*, Vol. 13, No. 3, October 2008, pp. 45-72, Accessed on 15/04/2013.

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)[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)[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

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[34] Christian R. Vogl, Lukas Kilcher and Hanspeter Schmidt, "Are Standards and Regulations of Organic Farming Moving Away from Small Farmers' Knowledge?", *Journal of Sustainable Agriculture*, Vol. 26, No. 1, October 2008, pp. 5-26, Accessed on 15/04/2013.

[35] Donald W. Lotter, "Organic Agriculture", *Journal of Sustainable Agriculture*, Vol. 21, No. 4, October 2008, pp. 59-128, Accessed on 19/04/2013.

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

[36] Rebecka Milestad and Ika Darnhofer, “Building Farm Resilience: The Prospects and Challenges of Organic Farming”, *Journal of Sustainable Agriculture*, Vol. 22, No. 3, October 2008, pp. 81-97, Accessed on 10/05/2013.

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)

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[37] Rory Degenhardt, Ralph Martin and Dean Spaner, "Organic Farming in Central Alberta: Current Trends, Production Constraints and Research Needs", *Journal of Sustainable Agriculture*, Vol. 27, No. 2, October 2008, pp. 153-173, Accessed on 10/05/2013.

[38] Teodoro C. Mendoza, "Evaluating the Benefits of Organic Farming in Rice Agro Ecosystems in the Philippines", *Journal of Sustainable Agriculture*, Vol. 24, No. 2, September 2008, pp. 93-115, Accessed on 20/05/2013.

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)[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 51.1percent 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

[39] Xose A. Armesto Lopez, "Organic Farming in Spain- Two case Studies", *Journal of Sustainable Agriculture*, Vol. 31, No. 4, November 2008, pp. 29-55, Accessed on 20/05/2013.

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)[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)[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

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

[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)[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)[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

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[42] A. Dubey. and D.K. Dubey, Evaluation of Cost Effective Organic Fertilizers, Working Paper, Research and Development Centre, Kilpest India Ltd., Govindpura, Bhopal, Madhya Pradesh, India, April 2010, Accessed on 19/04/2012.

[43] R. Saha and V. K. Mishra, "Effects of Organic Residue Management on Soil Hydro- Physical Characteristics and Rice Yield in Eastern Himalayan Region, India", *Journal of Sustainable Agriculture*, Vol. 33, No. 2, February 2009, pp. 161-176, Accessed on 10/05/2013.

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)[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

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[44] Kanokporn Rattanasuteerakul and Gopal B. Thapa, "Towards Organic Vegetable Farming in Mahasarakham Province, Thailand", *Journal of Sustainable Agriculture*, Vol. 34, No. 1, December 2009, pp. 57-79, Accessed on 10/05/2013.

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)[45] 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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[45] Curtis W. Stofferahn, "Personal, Farm and Value Orientations in Conversion to Organic Farming", *Journal of Sustainable Agriculture*, Vol. 33, No. 8, November 2009, pp. 862-884, Accessed on 15/04/2013.

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

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[46]P.S. Brahmanand, B.C. Ghosh and N. Sahoo, "Effect of Organic and Inorganic Sources of Nitrogen on Productivity of Rice in Rice-Fish Farming System", *Archives of Agronomy and Soil Science*, Vol. 55, No. 6, November 2009, pp. 663-670, Accessed on 15/04/2013.

[47] Antonio M. Alonso and Gloria J. Guzman, "Comparison of the Efficiency and Use of Energy in Organic and Conventional Farming in Spanish Agricultural Systems", *Journal of Sustainable Agriculture*, Vol. 34, No. 3, March 2010, pp. 312-338, Accessed on 10/04/2013.

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)[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^{-1}) and farmyard manure (FYM) at 10t ha^{-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)[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

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[48] Anup Das, Gour Chandra Munda, Dharmendra Prasad Patel, Probir Kumar Ghosh, Shishomvanao Ngachan and Pankaj Baiswar, "Productivity, Nutrient Uptake, Post-Harvest Soil Fertility in Lowland Rice as Influenced by Compost made from Locally available Plant Biomass", *Archives of Agronomy and Soil Science*, Vol. 56, No. 6, September 2010, pp. 671-680, Accessed on 10/04/2013.

[49] Anup Das, Gour Chandra Munda, Dharmendra Prasad Patel, Probir Kumar Ghosh, Shishomvanao Ngachan, Pankaj Baiswar, A.S. Panwar and Satish Chandra, "Compost Quality Prepared from Locally Available Plant Biomass and their Effect on Rice Productivity under Organic Production System", *Journal of Sustainable Agriculture*, Vol. 34, No. 5, June 2010, pp. 466-482, Accessed on 10/04/2013.

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)[50] 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 u sing conversion factors (diesel oil = 56.31 MJ) and was expressed in MJ /ha^{-1}. The energy ratio was found by dividing the total energy

[50] E. Gundogmus, "Energy Input Use in Environmentally Friendly Farming Systems: A Comparative Analysis between Organic and Conventional Dried Fig Production", *Journal of Sustainable Agriculture*, Vol. 34, No. 7, September 2010, pp. 744-757, Accessed on 19/04/2013.

equivalents of the inputs into the total energy equivalent of fig yields in each production system. Statistical tests for signi cant 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 xed 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 bene t/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 g production was renewable energy, which was 2,578.91 MJ /ha higher than that of conventional g production. That is, 41 percent of less non-renewable energy was used on organic g production per hectare than in conventional g production. And total production cost per hectare was higher on organic farms. And also, the mean GPV and net incomes on organic dried g production were calculated as six percent and seven percent higher than those of conventional production respectively. The bene t-cost ratio of g production calculated was nearly the same in both production systems.

Kizos, Veiknontis and Ignacio (2010)[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

[51] Thanasis Kizos, George Veikontis and J. I. M. Guirao, "Comparison of Organic and Integrated Farming Systems: The Case of Sultana Table Grapes in Korinthos, Greece", *Journal of Sustainable Agriculture*, Vol. 35, No. 1, December 2010, pp. 27-47, Accessed on 20/05/2013.

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 far ms 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 signi cantly 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 certi cation it produced was necessary for exports and this was the main reason why they had chosen it.

Sheahan and others (2011)[52] 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 o f 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

[52] C.M. Sheahan, D.B. Bray, M.G. Bhat and K. Jayachandran, "Ecological, Economic and Organizational Dimensions of Organic Farming in Miami-Dade Country", *Journal of Sustainable Agriculture*, Vol. 36, No. 1, December 2011, pp. 83-105, Accessed on 20/05/2013.

farms that specialize in growing micro-greens and sprouts for high-end restaurants in Miami Beach, out of which one was certi ed bio-dynamic and the other was not certi ed organic, but was pesticide free and both of these farmers practiced no-till management in raised beds, a two five acre, certi ed 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 o f development, a 75 acre certi ed 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-certi ed 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 o f 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 xed and variable production costs. The largest costs reported among farmers surveyed were for labor, organic slow release fertilizer, manure, woodchips, certi ed 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)[53] made a study to investigate if financial support was the dominant reason for increasing diffusion in Lithuania and to understand why majority

[53] Peter Kaufman, Romualdas Zemeckis, Virgilis Skulskis, Emilijia Kairyte and Sigrid Stagl, "The Diffusion of Organic Farming in Lithuania", *Journal of Sustainable Agriculture*, Vol. 35, No. 5, June 2011, pp. 522-549, Accessed on 10/05/2013.

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 o f 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 far m related variables as,

$$y = ß_0 + ß_1 \text{(Info G)} + ß_2\text{(Disc O)} + ß_3\text{(OF management)} + ß_4\text{(Value)} + ß_5\text{(Farm type)} + e_i$$

where, y_i is the log odds of adoption for the ith farmer, and ei is the base of natural logarithms; $ß_0$ 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)[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)[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

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[54] Raj K. Adhikari, "Economics of Organic Rice Production", *The Journal of Agriculture and Environment,* Vol. 12, No. 1, June 2011, pp. 97-103, Accessed on 31/05/2016.

[55] David Perez Neira, Marta Soler Montiel and Xavier Simon Fernandez, "Energy Analysis of Organic Farming in Andalusia (Spain)", *Argoecology and Sustainable Food Systems*, Vol. 37, No. 2, December 2012, pp. 231-256, Accessed on 19/04/2013.

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 $(EP)_{(i)}$ = energy output $(EO)_{(i)}$ (MJ) × $area^{-1}$ $(A)_{(i)}$ (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.

[56] Venkat Kumar, "Comparison of twelve Organic and Conventional Farming Systems: A Life Cycle Greenhouse Gas Emissions Perspective", *Journal of Sustainable Agriculture*, Vol. 36, No. 6, July 2012, pp. 620-649, Accessed on 10/05/2013.

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)[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)[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.

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[57] Husnawati Yahya and Kwok Ching Wong, *Organic Rice Farming Systems in Taiwan: A Review of Technical and Economic Aspects*, 2nd International Conference on Environment, Agriculture and Food Sciences (ICEAFS'2013), Kuala Lumpur (Malaysia), May 6-7, 2013, pp. 94-96.

[58] M. I. Husnain and M. Khan, "The Public and Private Benefits from Organic Farming in Pakistan", Economics and the Environment, Working Paper No. 99, COMSATA Institute of Information Technology, Lahore, Pakistan, September 2015.

Nghia and Dzung (2016)[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 Bacthom 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 = Σ 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
3. Net income = Gross return – Total variable cost.

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)[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

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[59] Nguyen Thi Ai Nghia and Pham Tien Dzung, "Research and Promotion of Organic Rice Production in Hanoi, Vietnam", *International Journal of Agriculture Innovations and Research,* Vol. 4, No. 5, 2016, pp. 944-949.

[60] C. H. Hanumantha Rao, "Changes in Costs and Returns with the Use of High Yielding Seeds", *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)[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)[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

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[61] P.S. George, "Dilemma of Cost of Cultivation in Kerala", *Economic and Political Weekly, Vol. 23, No. 39,* September 24, 1988, pp. A – 129-132.

[62] D.O. Ohajanya and C.E. Onyenweaku, "Analysis of Costs and Returns in Rice Farming by Farm Sizes in Ebonyi state", J*ournal of Agriculture and Social Research,* Vol. 3, No. 1, 2003, pp. 29-39, Accessed on 15/09/2-13.

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 hich was higher for large rice farmers.

Suneetha and Kumar (2013)[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)[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.

[63] K. Suneetha and I. Narendra Kumar, "Cost and Returns Structure of Paddy in Andhra Pradesh", *Indian Journal of Research,* Vol. 3, Issue. 5, June 2013, pp. 40-42, Accessed on 15/09/2013.

[64] V. Nirmala, *Economic Analysis of Rice Cultivation: A Study of Tamil Nadu*, Concept Publishing Company, New Delhi, 1992, pp.112 -115.

Fermont, et al. (2009)[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)[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): $Y= a + b * x^{c,}$ 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

[65] A.M. Fermont, P.J.A. Van Asten, P. Tittonell, M.T. Van Wijk and K.E. Giller, "Closing the Cassava Yield Gap: An Analysis from Smallholder Farms in East Africa", *Fields Crop Research,,* Vol. 112*,* No. 1, 2009, pp.24-36, Accessed on 15/09/2014.

[66] Tomek de Ponti, Bert Rijk, Martin K. Van Ittersum, "The Crop Yield Gap Between Organic and Conventional Agriculture"*, Agricultural Systems,* Vol. 108, No.1, 2012, pp. 1-9, Accessed on 15/09/2014.

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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[67] A.K. Sen, "An Aspect of Indian Agriculture", *The Economic Weekly*, Vol. 14, No. 4-6, February 1962, pp. 243-246.

[68] A. K. Sen, "Size of Holdings and Productivity", *The Economic Weekly*, Vol. XVI, No. 18, February 1964.

[69] Dipak Mazumdar, "Size of Farm and Productivity: A Problem of Indian Peasant Agriculture", *Economica*, Vol. 32, No. 126, May 1965, pp. 161-173.

[70] C. H. Hanumantha Rao, "Alternative Explanations of the Inverse Relationship Between Farm Size and Output Per Acre in India", *Indian Economic Review*, Vol. 1, No. 1, October 1966, pp. 1-2.

[71] A. M. Khusro, "*Returns to Scale in Indian Agriculture*", in A.M. Khusro (Ed.) *Readings in Agriculture Development*, Allied Publishers, Delhi, 1968.

[72] A. P. Rao "Size of Holdings and Yield Per Acre", *Economic and Political Weekly*, November, 1967.

Rudra (1968)[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)[74] and challenged the validity of generalising the inverse relation for the whole of India. Krishna Bharadwaj (1974)[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)[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)[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)[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.

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[73] Ashok Rudra, "Farm Size and Yield per Acre", *Economic and Political Weekly*, July, Special Number, 1968a.

[74] Ashok Rudra, "More Returns to Scale in Indian Agriculture", *Economic and Political Weekly*, Review of Agriculture, October 26,1968b.

[75] Krishna Bharadwaj, *Production Conditions in Indian Agriculture – A study based on Farm Management Surveys*, Cambridge University Press, Cambridge, 1974.

[76] G. K. Chadha, "Farm Size and Productivity Re-visited – Some Notes from Recent Experience of Punjab", *Economic and Political Weekly*, Review of Agriculture, Vol. 13, No. 39, September 1978, pp. A87-A96.

[77] Ashok Rudra and Amartya Sen, "Farm Size and Labour Use: Analysis and Policy", *Economic and Political Weekly*, Vol. 15, February 1980.

[78] M. R. Carter, "Identification of the Inverse Relationship between Farm Size and Productivity: An Empirical Analysis of Peasant Agricultural Production", *Oxford Economic Papers,* Vol. 36 No. 1, March 1984, pp. 131-145.

Chattopadhyay and Sengupta (1997)[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)[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[81]; Newell, 1997[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.

[79] Manabendu Chattopadhyay and Atanu Sengupta, "Farm Size and Productivity – A New Look at the Old Debate", *Economic and Political Weekly*, Vol. 33, No. 26, June 27 – July 3, 1998, pp. A113-A116.

[80] Shenggen Fan and Connie Chan-Kang, "Is Small Beautiful? Farm Size, Productivity, and Poverty in Asian Agriculture", *Agricultural Economics,* Vol. 32, No. 1, January 2005, pp. 135–146.

[81] S. S. Bhalla and P. Roy, "Mis-Specification in Farm Productivity Analysis: The Role of Land Quality", *Oxford Economic Papers*, Vol. 40, No. 1, 1988, pp. 55-73.

[82] Andrew Newell, "Farm Size and the Intensity of Land Use in Gujarat", *Oxford Economic Papers*, Vol. 49, No. 1, 1997, pp. 307-315.

Cornia (1985[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[84]) also observed that the inverse relationship could be rejected at a higher level of agricultural technology.

Bhandari (2006)[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)[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

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[83] G. A. Cornia, "Farm Size, Land Yields and the Agricultural Production Function: An Analysis for Fifteen Developing Countries", *World Development*, Vol. 13, No. 1, 1985, pp. 513-534.

[84] A. B. Deolalikar, "The Inverse Relationship between Productivity and Farm Size: A Test Using Regional Data from India", *American Journal of Agricultural Economics,* Vol. 63, No. 1, 1981, pp. 275-279.

[85] R. Bhandari, "Searching for a Weapon of Mass Production in Nepal: Can Market Assisted Land Reforms Live Up to their Promise?", *Journal of Developing Societies,* Vol. 22, No. 1, 2006, pp. 111-143.

[86] Ramesh Chand, P. A. Lakshmi Prasanna and Aruna Singh, "Farm Size and Productivity: Understanding the Strengths of Smallholders and Improving Their Livelihoods", *Economic and Political Weekly,* Vol. XLVI, Nos. 26 & 27, June 25, 2011, pp. 5-11.

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.

CHAPTER- III

PROFILE OF THE STUDY AREA

This chapter presents the profile of the study area Nagaland by considering the relative importance of the issue discussed.

3.1 Location and People[1]

The state Nagaland and its people 'Nagas' are recognized for the numerous tribes and its rich culture. In total the state has 16 main tribes, when arranged alphabetically, they are Angami, Ao, Chakesang, Chang, Khiamnungan, Kachari, Konyak, Kuki, Lotha, Phom, Puchuri, Rengma, Sangtam, Sema, Yimchunger and Zeliangrong. The different tribes have their own distinctive dialects and cultures.

Nagaland is situated in the extreme North Eastern region in India, it is a hilly state with Kohima as its capital. The state is located in such a way that in the East lie Myanmar, Assam in the West, Arunachal Pradesh, and Manipur in the South. It is also known as one of the seven sisters of the North Eastern states. Nagaland has an area of 16,579 thousand hectare (Ha.). The state lies between $25^{0}60^{'}$ and $27^{0}40'$ latitude of North Equator and between $93^{0}20'$ and $95^{0}15'$ East of longitudinal lines. There are several rivers flowing through this state. Some of the main rivers are Dhansisri, Doyang, Dikhu, Tizu and Melak.

The state has 11 administrative districts, 52 blocks and nine census towns, covering 1,286 villages. Nagaland has often been called 'The land of festivals' because with its 16 major tribes, one or the other tribes would be celebrating its festival every month of the calendar year.

3.2 Temperature

Nagaland has a maximum temperature of 32^{0} C and the minimum of 04^{0} C. It has typical monsoon climate, with variation from tropical to temperate conditions. It has four seasons, viz., winter season (December to February); pre-monsoon season (March to April); monsoon season (May to September); and season of retreating

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[1] S.S. Rathore, "Paradigm Shift for Enhancing Rice Productivity in Nagaland: Existing Practices and their Refinement", *Environmental Information System (ENVIS) Bulletin, Himalayan Ecology,* Vol. 16, No. 2, 2008, pp. 17-25.

monsoon (October to November). The annual average rainfall registered in the state was 2500 mm during 2014[2].

3.3 Brief History[3]

The documented history about the Naga tribe being very sketchy and oral, it is difficult to give a detail and appropriate study about the state's history. However Ancient Indian Literature mentions of "Kiratas", golden skinned people who lived in the East. Plotemy, in his Geographia, around 150 A.D also mentioned of "the realm of the Naked". Even the origin of the word "Nagas" is still shrouded in mystery but all the people of Naga tribes believed that they migrated from the East and were already settled in the area before the arrival of the Ahoms, around 1228, under King Sukhapa. Then followed the expeditions of the Britishers against Naga villages.

And finally Nagaland state came into existence on December 1, 1963 as the 16th state of the Indian Union.

3.4 Political Background

The culture, values and systems of governance among the tribes are very peculiar. In fact all kinds of governance systems are found within this small geographical area. First is the autocracy of the Konyak tribe, where the 'Commoners' are not allowed to stand straight before the 'Chief'. Followed by the Chiefship of the Sumi tribe where the Chief's word is still considered law. Then the republican system of the Ao tribe, with election still existing among them and finally the pure democracy of the Angami tribe.

Like any other states of India, Nagaland is also headed by a Governor, and the Chief Minister, with a Council of other Ministers, plays a major role in the government activities. However, Nagaland has been approved a great extent of state self-government, unlike the other Indian states. A set of Councils at the village and tribal levels has been set up for each tribe to deal with local disputes. At present (2014), Shri P.B. Acharya is the governor of Nagaland and Shri T.R. Zeliang is the

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2 *"Nagaland Basic Report 2014*", Directorate of Information and Public Relations, Kohima, Nagaland, 2014.

3 Charles Chasie, "Nagaland in Transition", *India International Centre Quarterly,* Vol. 32, No. 2/3, 2005, pp. 253-264, Accessed on 19/09/2014.

Chief Minister with Naga People's Front (NPF) party as the ruling party. Nagaland has one Lok Sabha seat, one Rajya Sabha seat, and 60 Vidhan Sabha seats[4].

3.5 Population[5]

Nagaland has a total population of 1,980,602 as per the census 2011, of which male constitute 10,25,707 (51.79%) and female population accounts for the remaining 9,54,895 (48.22%). It has a sex ratio of 931 females per 1000 males. The urban population is 5,73,741 (28.97%) while the remaining 14,06,861 (71.03%) live in rural areas. The district-wise population details are given in the table – 3.1.

TABLE – 3.1
REGION-WISE POPULATION BY DISTRICT 2011

Sl. No.	State/District	Total Population	Rural Population (%)	Urban Population (%)
1.	Kohima	2,70,063	1,46,914 (54.39)	1,23,149 (45.61)
2.	Dimapur	3,79,769	1,82,492 (48.06)	1,97,277 (51.95)
3.	Phek	1,63,294	1,38,689 (84.93)	24,605 (15.07)
4.	Mokokchung	1,93,171	1,37,517 (71.19)	55,654 (28.81)
5.	Wokha	1,66,239	1,31,254 (78.96)	34,985 (21.05)
6.	Zunheboto	1,41,014	1,13,409 (80.43)	27,605 (19.58)
7.	Tuensang	1,96,801	1,59,960 (81.28)	36,841 (18.72)
8.	Mon	2,50,671	2,15,953 (86.15)	34,718 (13.85)
9.	Peren	94,954	80,153 (84.42)	14,801 (15.59)
10.	Kiphiri	74,033	57,536 (77.72)	16,497 (22.29)
11.	Longleng	50,593	42,984 (84.96)	7,609 (15.04)
	Nagaland	**19,80,602**	**14,06,861(71.03)**	**5,73,741 (28.97)**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 31.
Note: Bracket shows percentages.

Nagaland has a total population of 19,80,602 according to 2011 Census, out of which 71.03 percent belongs to rural area and only 28.97 percent in urban area. Among all the 11 districts, Dimapur has the highest number of population. Out of the total 3,79,769 people living in the district, 48.06 percent belongs to rural area and majority (i.e., 52.95%) belongs to urban area. The district Longleng has the lowest

[4] Government of Nagaland, Statistical Handbook of Nagaland 2011, *Directorate of Economics and Statistics,* Nagaland, 2014, p. 8.

[5] Ibid., p. 31

number of population (i.e., 50,593) of which majority are from rural area (i.e., 84.96%).

Among all the 11 districts, Dimapur is the only district with majority of the people living in urban areas. One of the main reason for this behavior would be the fact that it is the only commercial city with railway transport and domestic airport facilities in the state.

Table-3.2 presents the state-wise sex ratio in Nagaland based on 2011 Census.

TABLE-3.2
STATE-WISE SEX RATIO: 2011 CENSUS

Sl. No.	Districts	Person	Male	Female	Sex Ratio
1.	Kohima	2,70,063	1,40,118	1,29,945	927
2.	Dimapur	3,79,769	1,98,163	1,81,606	916
3.	Phek	1,63,294	83,684	79,610	951
4.	Mokokchung	1,93,171	1,00,229	92,942	927
5.	Wokha	1,66,239	84,429	81,810	969
6.	Zunheboto	1,41,014	71,169	69,845	981
7.	Tuensang	1,96,801	1,01,977	94,824	930
8.	Mon	2,50,671	1,32,062	118,609	898
9.	Perin	94,954	49,530	45,424	917
10.	Kiphire	74,033	37,758	36,275	961
11.	Longlen	50,593	26,588	24,005	903
12.	**Nagaland**	**19,80,602**	**10,25,707 (51.79%)**	**9,54,895 (48.21%)**	**931**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 31.

According to 2011 Census, Nagaland has a total population of 1,980,602, out of which 51.79 percent is male and 48.21 percent is female. The present sex-ratio in Nagaland is 931 female per 1000 male. Among all the districts, Zunheboto has the highest sex-ratio of 981 females per 1000 males, and Mon district has the lowest sex-ratio of 898 female per 1000 male. And there is no particular explanation for this behaviour, as in the state Nagaland, so far, there has been no such case of infant girl child murder, boy or a girl child are equally welcomed in every family in Nagaland.

3.6 Education[6]

Nagaland has total literate population of 13,57,579 (i.e., 68.54%) according to 2011 Census, out of the total State population of 19,80,602. Of the total literate population, males comprise 7,31,796 (i.e., 53.91%) and females are 6,25,783 (i.e., 46.09%). The number of schools by levels and higher educational institutions in Nagaland since 2008-09 and up to date are given in table-3.3.

TABLE - 3.3
NUMBER OF SCHOOLS AND HIGHER EDUCTIONAL INSTITUTIONS IN NAGALAND, Since 2008-09 and up to date

Sl. No.	Types of Institutions	Central (%)	State (%)	Private (%)	Total (%)
1.	Higher secondary	3 (4.35)	16 (23.19)	50 (72.46)	69 (100)
2.	High schools	10 (2.97)	109 (32.39)	218 (64.69)	337 (100)
3.	Middle schools	-	287 (61.72)	178 (38.28)	465 (100)
4.	Primary schools	-	1442 (86.76)	220 (13.24)	1662 (100)
5.	Nursing schools	-	3 (100)	-	3 (100)
6.	Teachers training institutes	-	1 (16.67)	5 (83.84)	6 (100)
7.	ITI	-	3 (100)	-	3 (100)
8.	Hindi training institutes	-	1 (16.67)	5 (83.84)	6 (100)
9.	School of music	-	-	1 (100)	1 (100)
10.	University	-	1 (100)	-	1 (100)
11.	Colleges of general education	-	13 (28.26)	33 (71.74)	46 (100)
12.	Agri. college	-	1(100)	-	1 (100)
13.	Nagaland college of teachers education	-	1(33.33)	2(66.67)	3(100)
14.	Theology (Govt recognised)	-	-	22(100)	22(100)
15.	Law college	-	-	3(100)	3(100)

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 8 and p. 99.
Note: % - Percentage; ITI - Indian Technological Institute; and Govt. – Government.

There are 69 Higher Secondary schools, of which 50 were run by private institutions, 16 by state government and only three by central government. Out of the

[6] Ibid., p. 8 and 99.

total 337 High Schools in Nagaland, majority are run by the private institutions i.e., 64.69 percent, followed by the state government i.e., 32.39 percent and only 2.97 percent (i.e., 10 high schools) are run by the central government. three Nursing Schools, three Indian Technological Institute (ITI), one University and one Agricultural College were fully managed by the state government. And one Music School, 22 Theology (government recognised), and three Law colleges were managed by the private institutions. And the remaining 465 Middle Schools, 1662 Primary Schools, six Teachers Training Institutes, six Hindi Training Institutes, 46 colleges of General Education, and three Nagaland College of Teachers' Education are run both by the state government and private authorities.

3.7 Health[7]

Table-3.4 gives details on the number of hospitals, dispensary and health-centres in Nagaland from 2007-08 to 2010-11.

During the period 2007-2011, the total number of hospitals, dispensaries and health centres did not show much change, i.e., 582. Throughout the period, sub-centres were about 398, 11 district hospitals and 21 community health centres. However, the primary health centre increased from 86 (2007-09) to 124 (2009-11), but the number of subsidiary health centre and dispensaries decreased drastically.

[7] Ibid., p. 125

TABLE- 3.4
NUMBER OF HOSPITALS

Sl. No.	Particulars	2007-08	2008-09	2009-10	2010-11
1.	District hospital	11	11	11	11
2.	Community health centre	21	21	21	21
3.	Primary health centre	86	86	124	124
4.	Subsidiary health centre	27	27	1	1
5.	Dispensary	15	15	3	3
6.	T.B. hospital	2	2	2	2
7.	Mental hospital	1	1	1	1
8.	Sub-centre	397	397	398	398
9.	S.T.D. clinic	8	8	8	8
10.	D.T.C	5	5	5	5
11.	Post Morton centre	3	3	3	3
12.	Para medical training institute	1	1	1	1
13.	School of nursing (GNM)	2	2	2	2
14.	School of nursing (ANM)	1	1	1	1
15.	State health food laboratory	1	1	1	1
16.	**Total**	**581**	**581**	**582**	**582**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 125.
Note: T.B. – Tuberculoses; S.T.D. – Sexually Transferable Diseases; D.T.C. - District Training Centre; G.N.M. – General Nursing and Midwifery; and A.N.M. - Appointment Management.

3.8 Industrial Background[8]

Nagaland is basically an agrarian state, but has been slowly developing industrially in recent times. So far, the data for MSME in Nagaland has been found only till the year 2009. The district-wise details of the number of Micro, Small and Medium Enterprises (MSME) registered and employees during the years 2007 to 2009 is shown in table - 3.5.

[8] Ibid., p. 156.

TABLE- 3.5
DISTRICT-WISE MICRO, SMALL AND MEDIUM ENTERPRISES AND EMPLOYMENT GENERATED

Sl. No.	District	2007		2008		2009-10	
		Registered	Employment Generated	Registe-red	Employment Generated	Registered	Employmen t Generated
1.	Kohima	73 (10.37)	1034 (7.84)	138 (6.69)	1831 (6.49)	52 (4.76)	571 (4.79)
2.	Dimapur	341 (48.44)	8279 (62.96)	792 (38.41)	13792 (48.89)	416 (38.09)	4636 (38.940
3.	Phek	17 (2.42)	175 (1.33)	65 (3.16)	935 (3.32)	18 (1.65)	258 (2.17)
4.	Mokok-chung	89 (12.65)	1264 (9.62)	128 (6.21)	2036 (7.22)	181 (16.78)	1903 (15.99)
5.	Wokha	61 (8.67)	798 (6.07)	45 (2.19)	659 (2.34)	16 (1.47)	173 (1.46
6.	Zunheboto	55 (7.82)	515 (3.92)	512 (24.83)	3383 (11.99)	217 (19.87)	2077 (17.45)
7.	Tuensang	32 (4.55)	501 (3.81)	158 (7.67)	1932 (6.85)	103 (9.44)	1081 (9.08)
8.	Mon	4 (0.57)	33 (0.25)	45 (2.19)	743 (2.64)	38 (3.48)	449 (3.77)
9.	Peren	2 (0.29)	33 (0.25)	35 (1.69)	632 (2.24)	5 (0.46)	65 (0.55)
10.	Kiphire	15 (2.13)	229 (1.74)	58 (2.82)	782 (2.78)	26 (2.38)	395 (3.32)
11.	Longleng	15 (2.13)	289 (2.19)	86 (4.17)	1480 (5.25)	20 (1.83)	299 (2.52)
12.	**Total**	**704 (100)**	**13150 (100)**	**2062 (100)**	**28205 (100)**	**1092 (100)**	**11907 (100)**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 156.
Note: Brackets show percentages.

The registered Micro, Small and Medium Enterprises (MSME) was 704 in the year 2007 generating employment to 1,315 persons, which later in the year 2008 increased to 2,062, generating employment to 28,205 persons. However during the year 2009-10, the number of MSME reduced to 1,092 employing 11,907 persons.

Throughout the years 2007 to 2009-10, Dimapur had the highest number of registered MSME and Peren had the lowest registered number. One reason would be that Dimapur being the city-centre of all the trade activities in Nagaland most of the small enterprises were registered there.

3.9 Banks[9]

In Nagaland, there are 111 banks, out of which State Bank of India (SBI) has been functioning as the lead bank. The district-wise bank details are shown in the table-3.6.

TABLE- 3.6
BANKS IN NAGALAND, 2011

Sl. No.	Bank	Kohima	Dima -pur	Phek	Mokok-chung	Wokha	Zunh-eboto	Tuen-sang	Mon	Kiphire	Peren	Long-leng	Total
1.	Allahabad Bank	-	2	-	2	-	-	-	-	-	-	-	4
2.	Bank of Boroda	1	1	-	1	1	-	-	-	-	-	-	4
3.	Central Bank	1	1	-	-	-	-	-	-	-	-	-	2
4.	Federal Bank	-	1	-	-	-	-	-	-	-	-	-	1
5.	ICICI	**1**	1	-	-	-	-	-	-	-	-	-	2
6.	Indian Bank	-	1	-	-	-	-	-	-	-	-	-	1
7.	Punjab and Sind Bank	-	1	-	-	-	-	-	-	-	-	-	1
8.	Punjab National Bank	-	1	-	-	-	-	-	-	-	-	-	1
9.	Syndicate Bank	-	1	-	-	-	-	-	-	-	-	-	1
10.	State Bank of India	8	11	5	6	5	5	4	3	1	2	1	51
11.	United Bank of India	1	1	-	-	-	-	-	-	-	-	-	2
12.	United Commercial bank	1	1	-	-	-	-	-	-	-	-	-	2
13.	Axis Bank	1	2	-	1	-	-	-	-	-	-	-	4
14.	Vijaya Bank	2	2	-	-	-	-	-	1	-	-	-	5
15.	IDBI	-	1	-	-	-	-	-	-	-	-	-	1
16.	Nagaland Rural Bank	3	2	-	1	1	1	-	-	-	-	-	8
17.	Nagaland State Cooperative Bank	4	5	3	3	1	1	1	1	1	1	-	21
18.	**Grand Total**	**23**	**35**	**8**	**14**	**8**	**7**	**5**	**5**	**2**	**3**	**1**	**111**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 70.

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[9] Ibid., p. 70.

The table clearly shows that in 2011, there were around 111 banks out of which 51 were State Bank of India (SBIs), and is the leading Bank in State. And Nagaland State Cooperative Bank was the second in lead i.e., 21 banks in state. District-wise, Dimapur has the highest number of banks (i.e., 31.53%) and all the kinds of banks functioning in the district, and the least is in Longleng district with only one SBI bank.

3.10 Transport Services[10]

Table- 3.7 gives information on the State Transport service by road in Nagaland from 2005-2010.

TABLE - 3.7
STATE TRANSPORT SERVICE (by road)

Sl. No.	Items	2005-06	2006-07	2007-08	2008-09	2009-10
1.	Length of routes covered by NST (in km)	N.A	10908	11414	11043	10775
2.	Average number of passengers handled daily	4753	4166	5128	4487	4807
3.	Average quantity of luggage handled daily (Quintals)	26	833	1026	100	128
4.	Number of employees	1050	1049	1050	1050	1050
5.	Number of vehicles	219	234	249	235	251
6.	Revenue earned (Rs. in lakhs)	734	803	840	910	1062
7.	Gross capital investment (Rs. in lakhs)	6738.34	7373.34	8265.53	8977.53	9619.53

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 236.
Note: N.S.T. – Nagaland Sate Transport; N.A. – Not Available; and Rs. – Rupee.

[10] Ibid., p. 236.

The length of routes covered by Nagaland transport service is 10,775 km and the average number of passengers handled daily was 4,407during 2009-10. The number of employees has remained the same throughout the years from 2005-2010 (i.e., 1050), but the revenue earned has increased from Rs.734 lakhs (2005-06) to Rs.1062 lakhs (2009-10). The gross capital investment also increased from Rs.6738.34 lakhs (2005-06) to Rs.9619.53 lakhs in 2009-10. And the number of vehicles used for transportation has increased slightly from 219 to 251.

3.11 State Economy[11]

Nagaland economy is mainly based on agriculture, as more than 60 percent of the population is engaged in this sector. It is also dependent on forestry, cottage industry and tourism. The gross State Domestic Product for Nagaland at factor cost by industry of origin at current price from 2004-05 to 2012-13 is shown in table-3.8.

TABLE-3.8
GROSS STATE DOMESTIC PRODUCT AT FACTOR COST by INDUSTRY: 2004-05 to 2012-13 (Rs. in Lakh) at Current Prices

Sl. No.	Sector	2004-05	2009-10	2010-11	2011-12	2012-13
I. Primary						
1.	Agriculture and allied	202912	281287	298965	316402	335647
a.	Agriculture	160164	218725	232790	247780	263735
b.	Forestry & logging	40402	57455	60712	62807	65319
c.	Fishing	2346	5107	5463	5815	6593
2.	Mining & quarrying	712	1361	1581	1771	1983
Total primary		**203624 (34.87)**	**282648 (26.85)**	**300546 (15.39)**	**318173 (25.93)**	**337630 (25.34)**
II. Secondary						
1.	Manufacturing	9841	27809	30871	33400	36619
2.	Construction	56724	128387	139457	151591	164781
3.	Electricity, gas and water supply	7953	19053	20053	21858	25983

[11] IndiaStat.com.

Total secondary		**74518 (12.76)**	**175249 (16.65)**	**190381 (16.83)**	**206849 (16.86)**	**227383 (17.07)**
Industry (Mining & quarrying + secondary)		**75230**	**176610**	**191962**	**208620**	**229366**
III. Services						
1.	Transport, storage & communication	57734	82676	86788	92669	99424
2.	Railways	327	805	855	908	964
3.	Transport by other means (including storage)	47956	63821	64141	65450	67413
4.	Storage	81	179	214	257	303
5.	Communication	9370	17871	21578	26054	30744
6.	Trade, hotels and restaurants	19627	40143	51383	59604	67556
7.	Banking and insurance	8371	17988	25087	31467	36469
8.	Real Estate, ownership of dwellings and business services	105139	209838	218617	233920	251004
9.	Public administration	68980	157966	165488	181821	199766
10.	Other services	45891	86169	93223	102712	112929
Total services		**305742 (52.36)**	**594780 (56.51)**	**640586 (56.62)**	**702193 (57.22)**	**767148 (57.59)**
State domestic product (Rs. Lakh)		**583884 (100)**	**1052677 (100)**	**1131513 (100)**	**1227215 (100)**	**1332161 (100)**
Population		**1781000**	**1932000**	**1952000**	**2015000**	**2079000**
State per capita income (Rs)		**32784.1**	**54486.4**	**57967**	**60904**	**64077**

Source: IndiaStat.com, Accessed on 04/09/2013.
Note: Bracket shows percentages.

During 2004-05, the highest contribution to gross State Domestic Product (SDP) of the State's economy was made by service sector, i.e., Rs. 3,05,742 lakhs (52.36%), followed by the primary sector (Rs. 2,03,624 lakhs - 34.87%) and secondary sector (Rs. 74,518 lakhs - 12.76%). Same trend of sector-wise contribution to the SDP are observed during 2012-13. However, contribution to SDP by primary sector reduced from 34.88 percent during 2004-05 to 25.35 percent during 2012-13, whereas the contribution of secondary and services sectors increased to17.07 and 57.59 percent respectively.

3.12 Employment Exchange Structure by Gender[12]

Gender wise description of the number of persons placed through employment exchange according to education level during 2008-10 are explained in detail in the table – 3.9.

TABLE – 3.9
GENDER-WISE NUMBER OF PERSONS PLACED THROUGH EMPLOYMENT EXCHANGE: 2008-10

Sl. No.	Education Level	2008			2009			2010		
		M	F	T	M	F	T	M	F	T
1.	Post Graduate	-	-	**0**	2	1	**3**	-	1	**1**
2.	Graduate	1	3	**4**	6	2	**8**	9	4	**13**
3.	Pre university	4	5	**9**	3	2	**5**	2	-	**2**
4.	Matriculate	2	4	**6**	7	1	**8**	1	3	**4**
5.	Below matriculate	10	3	**13**	10	-	**10**	7	-	**7**
6.	Degree(Technology)	-	-	**0**	-	-	**0**	-	-	**0**
7.	Diploma	-	-	**0**	-	-	**0**	-	-	**0**
8.	**Total**	**17**	**15**	**32**	**28**	**6**	**34**	**19**	**8**	**27**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 113.
Note: M = Male; F = Female; and T = Total.

In Nagaland, during 2008-10, the number of persons employed through the employment exchange has reduced from 32 to 27. When compared gender-wise, male persons employed had increased slightly from 17 to 19 persons during 2008-10, but the number of female-persons employed had fall from 15 to eight persons.

[12] Government of Nagaland, op. cit., p. 113.

Education-wise, majority of the persons employed had below matriculate education level during 2008 and 2009. However in the year 2010, majority of the persons employed had graduate education level.

3.13 Agriculture

Agriculture is the most important activity of the people. The economy's remarkable feature is that there is no landless peasant in the state. Paddy is the staple food crop of the state and is almost grown in the entire area from plain land (valley land) to hill slopes along an altitudinal gradient of 2500m elevation. Medziphema valley is known as the rice bowl of the state and is one of the most important regions of rice cultivation in the state. There exists great diversity in rice cultivation in respect of cultivars being used, soil and climatic conditions, geographical terrain, and management practices being followed.

The productivity of rice in country and in north eastern regions including Nagaland is low as compared to world average productivity. Rice is originated in the hot and humid tropics where heavy rains and floodwater create an aquatic environment for at least part of the year. Two systems i.e., lowland and upland cultivation are widely known practices of rice cultivation worldwide. In Nagaland, three types of paddy cultivation have evolved from time immemorial: (i) Jhum paddy cultivation; (ii) Wet Rice cultivation (WRC) and, (iii) Wet Terrace Rice cultivation (WTC). Jhum land and terrace rice cultivation is mainly practiced in the hilly terrain areas. The agriculture in Dimapur district is TRC, rainfed and tradional. By and large mono cropping is practiced in the district. The TRC paddy alone covers an area of 84,820 ha whereas Jhum covers about 96,570 ha. Besides the second important crop in the district is Kharif, Maize covers about 68,430ha[13].

The gross and net irrigated area under crops in Nagaland is shown in the table-3.10[14].

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[13] Rathore, op. cit., p. 21.

[14] Government of Nagaland, op. cit., p. 25.

TABLE-3.10
GROSS AND NET IRRIGATEDAREA UNDER CROPS IN HECTARES

Sl. No.	District	1987-88		1993-94		2000-01		2010-11	
		G.I.A (%)	T.N.I.A (%)	G.I.A (%)	T.N.I.A (%)	G.I.A (%)	T.N.I.A (%)	G.I.A (%)	T.N.I.A (%)
1.	Kohima	19483.7 (37.35)	18018.6 (35.55)	19483.7 (38.82)	14777.9 (39.15)	17693.8 (17.60)	10033.6 (20.96)	13393.45 (12.98)	7056.81 (11.58)
2.	Mokokchung	4513.00 (8.65)	4513.00 (8.91)	5029.75 (10.02)	4513.00 (11.96)	9593.65 (9.54)	4019.77 (8.39)	10941.55 (10.60)	5601.69 (9.19)
3.	Mon	2149.10 (4.12)	2149.10 (4.24)	2149.10 (4.28)	1441.96 (3.82)	2980.33 (2.97)	2030.62 (4.24)	3197.63 (3.09)	2332.30 (3.83)
4.	Phek	13380.7 (25.65)	13380.7 (26.39)	13380.7 (26.66)	9390.11 (24.88)	12069.1 (12.01)	8881.44 (18.56)	14125.40 (13.69)	9441.95 (15.48)
5.	Tuensang	5321.00 (10.20)	5313.70 (10.48)	5321.00 (10.60)	3997.87 (10.59)	10920.0 (10.86)	6407.80 (13.39)	7940.20 (7.69)	6476.49 (10.63)
6.	Wokha	2705.30 (5.186)	2705.30 (5.34)	2775.90 (5.53)	2173.36 (5.76)	3997.87 (3.98)	2054.45 (4.29)	4023.89 (3.89)	2269.15 (3.72)
7.	Zunheboto	4612.90 (8.84)	4612.90 (9.10)	2049.40 (4.08)	1450.65 (3.84)	9722.40 (9.67)	6254.80 (13.07)	10187.70 (9.87)	6120.50 (10.04)
8.	Dimapur	-	-	-	-	34104.8 (33.93)	8176.35 (17.09)	28362.20 (27.48)	14444.6 (23.69)
9.	Kiphire	-	-	-	-	-	-	2374.25 (2.30)	1500.50 (2.46)
10.	Longleng	-	-	-	-	-	-	2314.00 (2.24)	1337.00 (2.19)
11.	Peren	-	-	-	-	-	-	6357.58 (6.16)	4382.17 (7.18)
12.	**Total**	**52165.70 (100)**	**50693.30 (100)**	**50189.55 (100)**	**37744.91 (100)**	**100525.01 (100)**	**47858.89 (100)**	**103217.85 (100)**	**60963.19 (100)**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 25.
Note: G.I.A. – Gross Irrigated Area, and T.N.I.A. – Total Net Irrigated Area; and Bracket shows percentages.

The table clearly shows that during the years 1987-88 to 1993-94, only seven out eleven districts indulged in crop cultivation. And during these years, Kohima had the highest gross irrigated area and net irrigated area. During 2000-01, Dimapur district had the highest gross irrigated area, but its net irrigated area was less. But during 2006-07, Dimapur again had the highest gross irrigated area and net irrigated area. It was during these years that the other three districts, like Kiphire, Longleng and Peren, was formed as new districts and thus had very less irrigated area.

The cropping pattern of paddy crops in Nagaland with details of area and production from 2006-07 to 2010-11, is given in table-3.11[15].

[15] op. cit., p. 36 – 47.

TABLE-3.11
TOTAL AREA AND PRODUCTION OF PADDY CROPS IN NAGALAND

Sl. No.	Years	Jhum Paddy		TRC/WRC Paddy		Total	
		Area in Ha.	Production in M.T.	Area in Ha.	Production in M.T	Total Area in Ha.	Total Production in M.T.
1.	2006-07	99,980 (60.71)	1,60,000 (60.72)	64,700 (39.29)	1,03,520 (39.28)	1,64,680 (100)	2,63,520 (100)
2.	2007-08	97,420 (58.16)	1,66,460 (53.47)	70,080 (41.84)	1,44,840 (46.53)	1,67,500 (100)	3,11,300 (100)
3.	2008-09	95,780 (55.04)	1,71,080 (50.74)	70,300 (44.96)	1,74,010 (49.26)	1,66,080 (100)	3,37,160 (100)
4.	2009-10	90,900 (53.93)	1,10,300 (45.89)	77,670 (46.08)	1,30,010 (54.11)	1,68,570 (100)	2,40,310 (100)
5.	2010-11	96,570 (53.24)	1,73,830 (48.94)	84,820 (46.76)	2,07,530 (51.06)	1,81,390 (100)	3,55,220 (100)

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, pp. 36-47.
Note: Brackets show percentages; TRC/WRC – Terrace Rice Cultivation/ Wet Rice Cultivation; M.T. - Metric Ton; and Ha. – Hectares.

During the period 2006-07 to 2010-11, total area under paddy crops in Nagaland has increased from 1,64,680 ha to 1,81,390 ha and the total productivity has also increased from 2,63,520 M.T to 3,55,220 M.T.

Among the two type of paddy cultivation, the Jhum paddy had majority of the area throughout the period. In case of productivity, till the year 2008-09, Jhum paddy had more productivity then TRC/WRC paddy. But during 2009-10 and 2010-11, majority of productivity was from TRC/WRC paddy.

District-wise area and production of paddy crops in Nagaland during 2010-11 is presented in table-3.12[16].

[16] Ibid., p. 44.

TABLE-3.12
AREA AND PRODUCTION OF PADDY CROPS BY DISTRICTS: 2010-11

Sl. No.	**District**	**Jhum Paddy**		**TRC/WRC Paddy**	
		Area in Ha.	**Production in M.T.**	**Area in Ha.**	**Production in M.T.**
1.	Kohima	9880 (10.23)	17820 (10.26)	8050 (09.49)	19620 (09.46)
2.	Phek	1960 (02.03)	3400 (01.96)	11920 (14.06)	29610 (14.27)
3.	Mokokchung	11670 (12.09)	21000 (12.08)	6000 (07.08)	14670 (07.07)
4.	Tuensang	11490 (11.89)	20810 (11.98)	3550 (04.19)	8840 (04.26)
5.	Mon	9800 (10.15)	17680 (10.17)	3080 (03.64)	6840 (03.29)
6.	Dimapur	9620 (09.97)	17170 (09.88)	35310 (41.63)	85610 (41.25)
7.	Wokha	11670 (12.09)	21200 (12.19)	6400 (07.55)	15730 (07.58)
8.	Zunheboto	9720 (10.07)	17450 (10.04)	2680 (03.16)	6710 (03.24)
9.	Peren	4470 (04.63)	7980 (04.59)	6780 (07.99)	16950 (08.17)
10.	Kiphire	9080 (09.41)	16400 (09.44)	840 (0.99)	2250 (01.09)
11.	Longleng	7210 (07.47)	12920 (07.44)	210 (0.25)	700 (0.34)
12.	**Total**	**96570 (100)**	**173830 (100)**	**84820 (100)**	**207530 (100)**

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 44.
Note: M.T. - Metric Ton; Ha. – Hectares, and Bracket shows percentages.

During 2010-11, area under Jhum cultivation was the largest in Mokokchung and Wokha(i.e., 12.09% of total area under Jhum cultivation) and the lowest in Phek (i.e., 2.03%).Production under Jhum cultivation was highest in Wokha (i.e., 12.19% of the total production), followed by Mokokchung (i.e., 12.08%) and the least was produced by Phek (i.e., 1.96%). Area under Terrace Rice Cultivation (TRC) or Wet Rice Cultivation (WRC) was the largest in Dimapur (i.e., 41.63% of total area under TRC/WRC), followed by Phek (i.e., 14.06%) and the lowest was in Longleng (i.e., 0.25%).The production under TRC/WRC was found to be the highest in Dimapur 85,610 M.T followed by Phek (i.e., 29,610) and least was produced in Longleng (i.e., 700 M.T).

Details of land utilization in Nagaland from 2007-08 to 2010-11 is explained in table-3.13[17].

TABLE-3.13
AREA UNDER DIFFERENT LAND USES IN NAGALAND IN HECTARES

Sl. No.	**Land Classification**	**2007-08**	**2008-09**	**2009-10**	**2010-11**
1.	Total Geographical Area	1657900 (100%)	1657900 (100%)	1657900 (100%)	1657900 (100%)
2.	Area under forest	862930 (52.05%)	862930 (52.05%)	862930 (52.05%)	862930 (52.05%)
3.	Area not available for cultivation, excluding follow land	252385 (15.23%)	278938 (16.83%)	228507 (13.79%)	244909 (14.78%)
4.	Fallow land	186454 (11.25%)	162892 (09.83%)	160293 (09.67%)	155126 (09.36%)
5.	Total cropped area	399878 (24.12%)	401791 (24.24%)	481316 (29.03%)	452471 (27.29%)
6.	Area sown more than once	84000 (05.07%)	86221 (05.21%)	121000 (07.29%)	96190 (05.815)
7.	Net area sown (No.5- No.6)	315878 (19.06%)	315570 (19.04%)	360316 (21.74%)	362231 (21.85%)
8.	Net irrigated area	70080 (04.23%)	77320 (04.67%)	72670 (04.39%)	60963.19 (03.68)
9.	Gross irrigated area	76100 (04.59%)	82150 (04.96%)	77670 (04.69%)	103217.85 (06.23)

Source: *Statistical Handbook of Nagaland 2011,* Directorate of Economics and Statistics, Government of Nagaland, Nagaland, 2014, p. 49.

[17] Ibid., p. 49.

Out of the total geographical land, more than half (i.e., 52.05 %) is under forest. Area unavailable for cultivation is 14.78 percent, and fallow land is 09.36 percent during 2010-11. The latter decreased compared to the year 2007-08 (11.25%). Whereas net sown area has increased from 19.06 percent during 2007-08 to 21.85 percent during 2010-11.But not much change has been observed in net irrigated area and gross irrigated area, during 2010-11, net irrigated area has been 03.68 percent and gross irrigated area has been 06.23 percent.

Sixteen different rice varieties are cropped in Nagaland, out of which TRC-87-251 yields the highest amount of paddy and Hingjeera yields the least. When looked at from duration of plantation point of view, Naga Local/Special rice takes the longest (160-170 days). And three varieties Desang, Luit and Kelang take the shortest duration (95-100 days) in a year[18]. Of all these sixteen varieties of rice, Ranjit and Naga Local/Special rice are mostly cropped by the farmers in the profile study area (i.e., Kuhuboto area). Therefore the two varieties have been chosen for the study.

3.14 Consumption of Pesticides and Fertilizers by the State

The number of sale points for distribution of pesticides in various North Eastern States and India are shown in table-3.14[19].

The table shows that Nagaland has the least sale points among the North-Eastern states in India, with around 48 sale points for distribution of pesticides, which is only 0.03 percent of the total sale points in India (i.e., 141040). Out of the total 48 sale points, 33 are State Department of Agriculture and the rest 15 private trade. Comparing all the North-Eastern states in India, Assam has the highest number of sale points (i.e., 4507), but when compared to whole India, it comprises only around 3.19 percent of the total sale points.

[18] Rathore, op cit., pp. 20 - 21.

[19] http://ppqs.gov.in/IpmPesticides_cont.htm

TABLE-3.14
NUMBER OF SALE POINTS FOR DISTRIBUTION OF PESTICIDES AS ON 01.08.2010

Sl. No	Sates/UTs	Distribution Points				
		No. of State Department Agriculture	**No. of Cooperative Agros'**	**No. of Other Institutes**	**No. Private Trade**	**Total**
1.	Assam	-	121 (1.25)	-	4386 (3.45)	4507 (3.19)
2.	Arunachal Pradesh	Not reported				
3.	Manipur	-	-	-	153 (0.12)	153 (0.11)
4.	Meghalaya	85 (2.23)	1 (0.01)	-	42 (0.04)	128 (0.09)
5.	Mizoram	64 (1.68)	-	-	14 (0.01)	78 (0.06)
6.	Nagaland	33 (0.87)	-	-	15 (0.01)	48 (0.03)
7.	Sikkim	166 (4.35)	6 (0.06)	-	-	172 (0.12)
8.	Tripura	382 (10.01)	1 (0.01)	-	692 (0.55)	1075 (0.76)
9.	**India**	**3817 (100)**	**9680 (100)**	**576 (100)**	**126967 (100)**	**141040 (100)**

Sources: Statistics of Pesticides; http://ppqs.gov.in/IpmPesticides_cont.htm, Accessed on 04/09/2013.
Note: No. – Numbers; and Bracket shows percentages.

Consumption of pesticides of technical grade by different North-East States and India during 2000-01 to 2012-13 is given in table 3.15[20].

The table clearly indicates that the total consumption of pesticides in North Eastern States compared to India's consumption since 2000-01 to 2012-13, has been decreasing from 0.72 percent to 0.52 percent. Among the North Eastern States, Assam has consumed the highest amount of pesticides (i.e., 0.56 percent during 2000-01 and 0.41 percent during 2012-13), where as the position of Nagaland in pesticides consumption has remained the least. But it is also observed that during these years (i.e., 2000-01 to 2012-13) the consumption of pesticides in Nagaland has increased from 0.018 percent to 0.035 percent.

[20] IndiaStat.com

TABLE-3.15
PESTICIDES CONSUMPTION of NORTH EAST STATES and INDIA
(2000-2001 to 2012-13 as on 13.02.2013)

Sl. No.	States/UTs	2000- 01	2004- 05	2009- 10	2010- 11	2011- 12	2012- 13
1.	Assam	245 (0.56)	170 (0.42)	19 (0.045)	150 (0.27)	160 (0.31)	183 (0.41)
2.	Arunachal Pradesh	13 (0.03)	17 (0.042)	10 (0.024)	10 (0.018)	17 (0.032)	-
3.	Manipur	20 (0.05)	26 (0.064)	30 (0.072)	30 (0.054)	33 (0.062)	30 (0.066)
4.	Meghalaya	6 (0.01)	8 (0.019)	6 (0.014)	10 (0.018)	9 (0.017)	-
5.	Mizoram	8 (0.018)	25 (0.062)	39 (0.093)	4 (0.007)	4 (0.008)	4 (0.009)
6.	Nagaland	8 (0.018)	5 (0.012)	14 (0.033)	-	15 (0.028)	16 (0.035)
7.	Sikkim	4 (0.009)	-	4 (0.009)	-	-	-
8.	Tripura	11 (0.03)	17 (0.042)	55 (0.13)	12 (0.023)	266 (0.51)	-
9.	**Total of North East States**	**315 (0.72)**	**268 (0.66)**	**177 (0.42)**	**216 (0.39)**	**504 (0.95)**	**233 (0.52)**
10.	**India**	**43584 (100)**	**40672 (100)**	**41822 (100)**	**55540 (100)**	**52979 (100)**	**45386 (100)**

Source: IndiaStat.com, Accessed on 04/09/2013.
Note: Bracket shows percentages.

Consumption of fertilisers in north-East States and India during 2011-12 is shown in table-3.16[21].

During the year 2011-12, the Western states of India had consumed the highest amount of fertilizers, i.e., 31.03 percent of the total consumption in the country. Of all the states in the country, the North-East zone has consumed the least amount of fertilizers, i.e., only 1.12 percent. And among all the North-Eastern states, Assam has the highest consumption of fertilizers, followed by Tripura. Nagaland is the lowest consumer of fertilizers, compared to all other states in the country, with only 0.0052 percent.

[21] Ibid.

TABLE- 3.16
FERTILISERS CONSUMPTION IN NORTH-EAST STATES and INDIA: (2011-12) in '000 tonne

Sl. No.	States/UTs	N	P	K	Total
1.	Sub-Total (South Zone)	4028.31 (23.29)	2216.60 (28.01)	1021.71 (40.46)	7266.62 (26.19)
2.	Sub-Total (West- Zone)	5129.57 (29.65)	2776.07 (35.08)	701.60 (27.78)	8607.24 (31.03)
3.	Sub-Total (North Zone)	5727.62 (33.11)	1913.38 (24.18)	231.37 (9.16)	7872.37 (28.38)
4.	Sub-Total (East- Zone)	2241.20 (12.96)	950.67 (12.013)	491.54 (19.46)	3683.41 (13.28)
5.	Assam	151.05 (0.87)	49.08 (0.62)	75.52 (2.99)	275.65 (0.99)
6.	Tripura	10.42 (0.06)	5.49 (0.07)	2.73 (0.11)	18.64 (0.07)
7.	Manipur	6.59 (0.04)	0.97 (0.01)	0.44 (0.02)	8 (0.03)
8.	Meghalaya	3.27 (0.02)	1.24 (0.02)	0.25 (0.01))	4.76 (0.02)
9.	Nagaland	0.75 (0.01)	0.49 (0.01)	0.20 (0.01)	1.44 (0.01)
10.	Arunachal Pradesh	0.55 (0.01)	0.10 (0.001)	0.03 (0.001)	0.68 (0.0036)
11.	Mizoram	0.92 (0.005)	0.21 (0.003)	0.06 (0.002)	1.19 (0.0043)
12.	Sikkim	-	-	-	-
13.	Sub-Total (North - East Zone)	173.55 (1.01)	57.58 (0.73)	79.23 (3.14)	310.36 (1.12)
14.	**India**	**17300.25 (100)**	**7914.00 (100)**	**2525.45 (100)**	**27740 (100)**

Source: Indiastat.com, Accessed on 04/09/2013.
Note: Bracket shows percentages.

3.15 Extension Service and Credit provided to the Naga Farmers[22]

The extension services beneficiaries (both male and female), organized by the Agricultural Technology Management Agencies (ATMA) in Nagaland during 2013-14 is explained in detail in the table- 3.17

[22] Ibid.

TABLE – 3.17
NUMBER OF FARMERS BENEFITTED FROM EXTENSION SERVICES ORGANIZED BY AGRICULTURE TECHNOLOGY MANAGEMENT AGENCIES NICHE (ATMA) NAGALAND EXTENSION STATE REFORMS. [2013–14]

Sl. No.	Extension Service Activities:	Male	Percentage	Female	Percentage	Total	Percentage
1.	Expo – visit	13015	69.68	5664	30.32	18679	100
2.	Training	13992	72.33	5352	27.67	19344	100
3.	Demo	1639	100	-	-	1639	100
4.	Kishan Melas	52015	99.71	156	0.29	52171	100
5.	**Total**	**80661**	**87.84**	**11172**	**12.16**	**91833**	**100**

Source: IndiaStat.com, Accessed on 13/09/2014

Of all the four extension service activities, organized by the ATMA, Nagaland, majority of the farmers has been benefitted from the Kisan Melas activity, out of which 99.71 percent were male and only 0.29 percent were female. Out of all the total 91,833 beneficiaries, 87.84 percent were male and only 12.16 percent were female.

Table 3.18 gives detail on the loan/ credit/ advances provided to the agricultural farmers and its outstanding loans during 2014 in Nagaland by the cooperative and Regional Rural Banks (RRB).

The table highlights that only the RRB has provided loan during the year 2014 with a total number of account of 1334. And has provided credit to the farmers of the total amount of Rs.4.32 crores and with an outstanding loan of Rs.32,380.

TABLE – 3.18
LOAN/ADVANCES OUTSTANDING TO AGRICULTURAL FARMERS IN RESPECT OF COOPERATIVE AND REGIONAL AND RURAL BANK (RRB) IN NAGALAND [2014]

Sl. No.	Banks	No. of Account	Amount (Rs. Crores)	Loan Outstanding (Rs. '000)
1.	Cooperative banks	-	-	-
2.	Regional and rural banks	1334	4.32	32.38
3.	**Total**	**1334**	**4.32**	**32.38**

Source: IndiaStat.com, Accessed on 13/09/2014

3.16 Village Profile of Dimapur district

The number of villages, number of farming households, Gaun Buras (GBs), Village Council members (VC) and Village Development Board members (VDB) within Dimapur district during 2011 is presented in table – 3.19[23].

TABLE – 3.19
VILLAGE PROFILE OF DIMAPUR DISTRICT: 2011-12

Sl. No.	Particulars		Sub-Division		
			Dimapur Sadar	Niuland	Total
1.	No. of villages		140	65	205
2.	No. of farming household		27836	7826	35662
3.	Farming population	M	99716 (54.33)	18652 (49.31)	118368
		F	89646 (48.84)	19266 (50.94)	108912
		T	183552 (100)	37826 (100)	221378
4.	No. of GBs		384	180	564
5.	No. of VC members		1499	583	2082
6.	No. of VDB management board	M	802 (73.92)	331(80.33)	1133 (75.69)
		F	283 (26.08)	81(19.67)	364 (24.32)
		T	1085 (100)	412 (100)	1497 (100)

Source: Office Record, District office, Dimapur, Nagaland.
Note: GB – Gaun Bura; VC – Village Council; VDB – Village Development Board; M – Male; F – Female; T – Total; and Bracket shows percentages.

The table shows that during the year 2011, in Dimapur district, there are 205 villages, out of which 140 is from Dimapur Sadar area and 65 from Niuland area. Total number of farming households is 35,662, out of which 27,836 is in Dimapur

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[23] Office Record, District office, Dimapur, Nagaland.

Sadar area, and 7,826 in from Niuland area, and out of the total farming population i.e., 1,83,552, 54.33 percent is male and 48.84 percent is female. The table also shows that total number of GBs in Dimapur district is 564, out of which, 384 is from Dimapur Sadar area, and 180 is from Niuland area. And the total number of VC members is 1133, out of which, 1499 is from Dimapur Sadar area, and 583 is from Niuland area. The total number of VDB member is 1497, out of which, 1085 is from Dimapur Sadar area and 412 is from Niuland area and out of which 75.69 percent is male and 24.32 percent is female.

Table 3.20 gives general information of Dimapur district in Nagaland[24].

TABLE – 3.20
GENERAL INFORMATION OF DIMAPUR DISTRICT, 2012-13

Particulars	
1. Total Geographical area	92,700 hectares
2. Size of population	379,769
(a) Male	198,163
(b) Female	181,606
3. Number of households	35662
4. Average size of family	10
5. Total cropped area	68,670 hectares
6. Area under Rice	44,930 hectares
(a) Jhum Paddy	9,620 hectares
(b) TRC/WRC Paddy	35,310 hectares

Source: Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.

The district has a total geographical area of 92700 hectares. The total cropped area was accounted to be around 68670 hectares which is 74.08 percent of total geographical area during 2012-13. About 65.43 percent came under rice cultivation. And of the total area under rice cultivation, terrace or wet rice cultivation consist of around 76.88 percent of the total area. Thus, Dimapur district is found to be mainly an agrarian economy with nearly three-fourth of the total area under cultivation.

[24] Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.

The table also shows that male population was more than the female population in Dimapur district. The land use pattern of Dimapur district divided into two sub-divisions Dimapur Sadar and Niuland is explained in table 3.21[25].

TABLE – 3.21
LAND USE PATTERN OF DIMAPUR DISTRICT, 2012-13

Sl. No.	Land Classification	Sub Divisions of Dimapur District	
		Dimapur Sadar	**Niuland**
1.	Total geographical area in Ha.	81300 (100)	36700 (100)
2.	Area under forest in Ha.	17901 (22.02)	7145 (19.47)
3.	Area under jhum cultivation in Ha.	20154 (24.79)	13386 (36.48)
4.	Area under WRC/TRC in Ha.	21869 (26.90)	11031 (30.06)
5.	Area under horti./cash crops in Ha.	8708 (10.71)	2933 (7.99)
6.	Area not available for cultivation in Ha.	12668 (15.58)	2205 (6.01)

Source: Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.
Note: W.R.C. – Wet Rice Cultivation; T.R.C. – Terrace Rice Cultivation; and Horti. – Horticulture; and Bracket shows percentages.

The table gives clear information that among the two sub-divisions of Dimapur district i.e., Dimapur Sadar and Niuland, the former has more geographical area then the latter. Within the Dimapur Sadar sub-division, the area under Wet/ Terrace rice cultivation was has higher area then any other classifications (i.e., 26.90%). However within the Niuland sub-division, area under Jhum cultivation had higher area compared to all the other land classifications.

Of all the 140 villages in Dimapur Sadar sub-division, Kuhuboto area which consisted of 22 villages were chosen as this area was inhabited by only Sumi tribe, whereas other villages under Dimapur Sadar were inhabited by a mixture of all the Naga tribes. Thus concentrating only on the Sumi farmers, Kuhuboto area was selected, out of which only two villages were chosen i.e., Suhoi and Kuhuboto main village. The reason for this selection is, among all the 22 villages these two villages had highest number of farming households, and had all the basic facilities, like health centre, electricity, and water supply. And another important factor was that majority of the farmers in these two villages were cultivating Ranjit in Suhoi and Naga Special

[25] Ibid.

Rice variety in Kuhuboto, which is the rice varieties selected for the comparative study of inorganic and organic type of cultivation.

Table 3.22 gives an account of the cropping pattern of the Dimapur district during 2012-13[26].

TABLE - 3.22
CROPPING PATTERN IN DIMAPUR, 2012-13

Sl. No.	Particulars	Area in Hectares	% to Total Cropped Area	Productivity (District) in M.T	% to State Productivity	State Productivity
1	Area under cereals	52170	75.97	116740	21.95	531860
2	Area under pulses	1990	2.90	1800	4.94	36460
3	Area under oilseeds	8590	12.51	8360	12.38	67530
4	Area under commercial crops	5920	8.62	74250	18.94	392170
5.	Total cropped area	68670	100			

Source: Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.

The data reveals that 75.97 percent of the total cropped area in Dimapur district was under cereals alone, than followed by other crops like oilseeds (12.51%), commercial crops (08.61%) and pulses (02.90%). This indicates the dominance of rice cultivation in the district. Percentage of district productivity of the crops with state productivity indicates that district productivity of cereals come up to 21.95 percent of the state productivity, commercial crops productivity of the district is around 18.94 percent, oilseeds around 12.38 percent and pulses around only 4.94 percent of the total state productivity. The details on principal crops grown in Dimapur district during 2012-13 is explained in table 3.23[27].

Rice cultivation alone covered 51.42 percent of the total cropped area. The crops grown in the rest of the areas were maize, maustard, soyabean, linseed, jute and so on. Thus rice turned out to be the crop which occupied the major portion of the cropped area in the district.

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[26] Ibid.

[27] Ibid.

TABLE – 3.23
AREA UNDER PRINCIPAL CROPS IN DIMAPUR, 2012-13

Sl. No.	Crops	Area in Hectares	Percentage to Total Cropped Area	Productivity (District) in M.T	State Productivity
1	Rice (TRC/WR(	35310	51.42	85610	207530
2	Maize	6680	09.73	13120	134000
3	Wheat	370	0.54	630	5340
4	Barley	60	0.09	90	730
5	Pea	660	0.96	600	6210
6	Lentil	440	0.64	330	1500
7	Soyabean	2010	02.93	2490	30430
8	Sesamum	620	0.90	390	2080
9	Mustard	4120	5.99	4130	27080
10	Linseed	1080	1.57	870	4580
11	Jute	770	1.12	1390	5400
12	Colocossia	240	0.35	2290	48490
13	Potato	590	0.86	7420	78400
Total cropped area		**68670**	**100**		

Source: Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.

The village profile of the Kuhuboto area under Dimapur district, which includes the total farming households in the villages, health centers, electricity supply, water supply, crops grown and food grain status during 2012-13 is explained in table 3.24[28].

[28] Ibid.

TABLE – 3.24
VILLAGE PROFILE OF KUHUBOTO AREA, DIMAPUR 2012-13

Sl. No.	Name	No. of Farming Households	Health Centre No/Yes	Electricity No/Yes	Water Supply No/Yes	Major Crops Grown		Food Grain Status
						Kharif	Rabi	
1.	Ahozhe	65	No	Yes	No	Paddy, Maize	Pulses, Oilseeds	SS
2.	Ghokito	111	No	Yes	No	Paddy, Maize, Sesamum	Mustard, Wheat, Linseed	SP
3.	Henivi	62	No	Yes	No	Paddy, Sesamum, Maize, Soyabean	Mustard, Pea, Linseed	SP
4.	Hoito	72	No	Yes	No	Paddy, Sesamum, Maize, Soyabean	Mustard, Pea, Linseed	SP
5.	Hukato	95	No	Yes	No	Paddy, Maize, Soyabean, Ginger	Mustard, Wheat, Linseed	SP
6.	Khehokhu	120	Yes	Yes	Yes	Paddy, Maize, Colocasia	Mustard, Linseed	SP
7.	Khughovi	130	No	Yes	No	Paddy, Maize, Jute, Soyabean, Sesamum	Mustard, Wheat, Vegs.	SP
8.	Kuhuboto Main	375	Yes	Yes	Yes	Paddy, Maize	Mustard, Linseed	SP
9.	Lotovi	165	Yes	Yes	No	Rice, Maize, Sugarcane, Soyabean	Tomato, Radish, Bean, Vegs.	SP
10.	Luzheto	128	No	Yes	No	Paddy, Maize	Oilseed	SP
11.	Nihoto	105	No	Yes	Yes	Paddy, Maize, Cofosia, Chilly	Mustard, Linseed, Cole crop	SP
12.	Nizhevi	58	No	Yes	Yes	Paddy, Maize	Mustard, Wheat, Linseed	SP
13.	Pukhaho	167	No	Yes	No	Paddy, Maize, Soyabean	Mustard, Linseed, Pea	SP
14.	S. Hotovi	138	No	Yes	No	Paddy, Maize, Soyabean, Ginger	Wheat, Mustard, Palm	SP
15.	Showba (old)	340	No	Yes	No	Paddy, Maize, Sesamum	Cabbage, Pea, Mustard	SS
16.	Suhoi	344	Yes	Yes	Yes	Paddy, Maize, Jute, Soyabean	Paddy, Pulses	SP
17.	Tokugha	141	No	Yes	No	Paddy, Maize	Mustard	SP
18.	Vihokhu	196	No	Yes	Yes	Paddy, Maize, Chilly, Soyabean	Mustard, Linseed, Potato	SP
19.	Vokuho	60	No	Yes	Yes	Paddy, Maize	Mustard	SP
20.	Xekiye	102	No	Yes	Yes	Paddy, Maize, Chilly, Colocasia	Mustard, Linseed, Cole crop	SP
21.	Xelhoze	81	No	Yes	No	Paddy, Maize, Soyabean	Mustard, Vegs.	SS
22.	Zuvukhu	54	No	Yes	Yes	Paddy, Maize	Mustard	D

Source: Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.
Note: SS - Sufficient; SP – Surplus; and D – Deficit.

Table clearly shows that Suhoi and Kuhuboto Main has the highest number of farming households, with all the three basic necessities like health centers, water supply and electricity supply. And in both the villages there has been surplus production of rice during 2012-13. Thus, making it quite obvious for the two selected villages to be the ideal one among all the villages in Kuhuboto area in Dimapur district.

Table 3.25 shows the variety wise rice cultivating farmers in the two selected villages Suhoi and Kuhuboto main[29].

TABLE – 3.25
VARIETY-WISE RICE CULTIVATING FARMERS IN SUHOI AND KUHUBOTO MAIN VILLAGES OF DIMAPUR DISTRICT, 2013-14

Rice Varieties	No. of Farmers	Percentage to Total Farm
	1. SUHOI VILLAGE	
1. Ranjit	130	37.79
2. Naga Special	50	14.54
3. IR-8	84	24.42
4. Moosuri	80	23.26
Total	**344**	**100**
	2. KUHUBOTO MAIN	
1. Ranjit	120	32
2. Naga Special	50	13.33
3. IR-8	105	28
4. Moosuri	100	26.67
Total	**375**	**100**

Source: Village Record, Village Council office, Kuhuboto Area, Dimapur District, 2013.

For both the villages, Ranjit rice variety was observed to have had the highest number of cultivators (i.e., 130 for Suhoi and 120 for Kuhuboto Main) as compared to other inorganic rice varieties. And in case of Naga Special rice variety, which is the only organic rice variety cultivated, the number of cultivators cultivating it was 50 for Suhoi and another 50 for Kuhuboto Main. Thus, concluding that census method was adopted to collect data from all the 100 organic farmers cultivating Nagaland Special rice variety in Suhoi and Kuhuboto villages, Dimapur, Nagaland. And in addition, a random sample of 250 inorganic farmers cultivating Ranjit rice variety was selected

[29] Village Record, Village Council office, Kuhuboto Area, Dimapur District, 2013.

from the two villages, as majority of the inorganic farmers cultivated Ranjit rice variety.

The hybrid Ranjit rice variety was notified by Central Variety Release Committee. And it is derived from cross between Pankaj and Mahsuri rice varieties, suitable for shallow water submergence situation matured in 150-155 days. It has potential to give 43 quintals per hectare of grain yields.

Table 3.26 gives the detail information of both the rice varieties selected for the study in the two selected villages of Dimapur district[30].

TABLE – 3.26
DETAILS OF RICE VARIETIES IN SUHOI AND KUHUBOTO VILLAGES OF DIMAPUR DISTRICT

Sl. No.	Details	Ranjit	Naga Special
1	Durations (days)	150-155	180-200
2	Plant height (cm)	118	150
3	Panicle height (cm)	27	25.80
4	Yield (Q/ha)	43	40.55

Source: Research Station Record 2012-13, Agriculture Department, Nagaland University, Medziphema, Nagaland, 2013.

The Naga Special rice is a local rice variety suitable for the local conditions of Nagaland. This local rice variety takes 180-200 days to be matured and has the potential to give 40.55 quintals per hectare of grain yields.

Table 3.27 shows the extension services provided in Dimapur district during 2012-13[31].

[30] Research Station Record 2012-13, Agriculture Department, Nagaland University, Medziphema, Nagaland, 2013.

[31] Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.

TABLE – 3.27
EXTENSION SERVICES PROVIDED IN DIMAPUR DISTRICT, 2012-13

Sl. No.	Proposed Strategies	No. of Extension units
1	Productivity improvement by intensification technology adoption in paddy	10
2	To enhance productivity of maize	05
3	To promote mustard cultivation	06

Source: Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District, 2013.

As the table clearly shows, the district has an effective agricultural extension system. This has resulted in the wide spread of agricultural information among the farmers in Dimapur district. As a result, advanced techniques of agricultural production are followed by them which lead to better productivity.

CHAPTER – IV

COST AND RETURN STRUCTURE OF ORGANIC AND INORGANIC RICE VARIETIES

Production of any output, especially in the case of rice cultivation is the result of careful and proficient usage of inputs. This chapter looks into the cost and return structure of farmers cultivating Ranjit (250 inorganic farmers) and Naga special (organic 100 farmers) rice varieties. The chapter also highlights their input and output structure, and labour requirements for the various farm activities involved in rice cultivation. The analysis is also conducted across farm sizes. To examine the farm-size effects, data collected have been divided into two groups of small farmers (with land ownership of less than 4.95 acres) and the medium farmers (with land ownership 4.95 to 12.36 acres). The chapter also provides an insight into the farm size distribution, age distribution, education level, relationship between farm size and productivity, debt, market channels and accessibility to extension services.

4.1 Farm Size Distribution

The distribution of the organic and inorganic farmers by farm size in the study area is shown in table 4.1.

TABLE – 4.1
FARM SIZE DISTRIBUTION: BY RICE VARIETIES

Sl. No.	Farm Size (in Acres)	Organic Farmers (Naga Special Rice)			Inorganic Farmers (Ranjit)			Total farmers
		Number	Land Holders		Number	Land Holders		
			Male	Female		Male	Female	
1.	Small Farmers	50 (50)	39 (52)	11 (52)	112 (44.8)	112 (44.8)	-	162 (46.29)
2.	Medium farmers	50 (50)	36 (48)	14 (56)	138 (55.2)	138 (55.2)	-	188 (53.72)
3.	Total	100 (100)	75 (100)	25 (100)	250 (100)	250 (100)	-	350 (100)

Note: Bracket shows percentages.

The number of small organic farmers is 50 and 112 inorganic farmers. Thus, there is a total of 162 small farmers (46.29%) out of the total sample 350 farmers. Medium farmers with the farm size of 4.95 to 12.36 acres of land holding, are 188 in total farmers (i.e., 53.72 percent), of which 50 are organic farmers and 138 inorganic farmers. The study reveals that out of the total 100 organic farmers owning land, 75 percent are males and 25 percent females. However, in the case of inorganic farmers there are no female cultivators.

4.2 Age and Education Distribution

Table 4.2 illustrates the age and education levels of the sample farmers during the survey.

TABLE – 4.2
AGE AND EDUCATION LEVELS OF FARMERS

Sl. No.	Details	No. of Farmers		Total Farmers
		Organic Farmers	Inorganic Farmers	
A.	**Age in Years:**			
1.	20 – 30	3 (3)	8 (3.2)	11(3.14)
2.	30 – 40	3 (3)	138 (55.2)	141 (40.29)
3.	40 – 50	48 (48)	104 (41.6)	152 (43.43)
4.	Above 50	46 (46)	-	46 (13.14)
	Total	100 (100)	250 (100)	350 (100)
B.	**Education Level:**			
1.	Illiterate	3 (3)	-	3 (0.86)
2.	High School	77 (77)	166 (66.4)	243 (69.43)
3.	Higher Secondary School	13 (13)	47 (18.8)	60 (17.14)
4.	College	7 (7)	37 (14.8)	44 (12.57)
	Total	100 (100)	250 (100)	350 (100)

Note: Bracket shows percentages.

The table shows that majority of the total farmers (i.e., 152 number of farmers) are in the age group of 40-50 years, followed by the age group of 30-40 years (40.29%). About 46 farmers (13.14%) come under the age group of above 50 years, while there are eleven farmers (3.14%) under the age group of 20-30 years. The table also shows that the number of illiterate farmers are three and number of farmers with high school education is 243, higher secondary is 60 and 44 have college education.

Rice variety-wise, under organic farming, majority (48%) of the farmers are in the age group of 40-50 years, followed by 46 percent in the age group of above 50 years. The remaining three percent of the farmers each belong to the age groups 20-30 years and 30-40 years. About 77 percent of the organic farmers had high school education, followed by 13 percent with higher secondary education, seven percent college level and only three percent illiterates. Under inorganic farming, 55.2 percent (i.e., majority) of the farmers are in the age group of 30-40 years, followed by 41.6 percent under 40-50 years of age group. Most of the inorganic farmers (66.4%) also have high school education, followed by higher secondary and college education. There are no illiterate farmers among the inorganic farmers.

4.3 Input and Output structure

The quantities of inputs applied for cultivation of the two rice varieties (organic and inorganic) per acre, and their outputs are shown in table – 4.3.1.

TABLE- 4.3.1
INPUT AND OUTPUT STRUCTURE PER ACRE OF ORGANIC AND INORGANIC RICE VARIETIES

Sl. No.	Particulars	Unit	Organic	Inorganic	Difference	t-value (Organic vs Inorganic)
1.	Seeds	Kg.	18.07	18.10	-0.03	-0.01
2.	Bullock labour	Pair	02	02	0.00	-
3.	Human labour	Mandays	179	119	60.00	3.48
4.	Chemical fertilizer/ Organic manure	Kg.	458.47	24.76	433.71	19.73
5.	Pesticides	Kg.	1.27	0.71	0.56	0.39
6.	Irrigation	Rs.	1262	1188	74	1.49
7.	Yield	Kg.	2014.77	3370.93	-1356.16	-18.48*
8.	Sample Size	-	100	250	-150	-

Note: * significance at one percent level; and kgs. = Kilograms

On an average, 18.10 kgs. and 18.07 kgs. seeds per acre are respectively required for inorganic and organic rice cultivation. The average requirement of human labour for inorganic cultivation is 119 mandays per acre, while for organic rice cultivation it is 179 mandays per acre. T-test result shows a significant difference of

3.48 human labour mandays between organic and inorganic rice cultivation. Bullock labour used per acre is almost the same, i.e., two pairs each for both the varieties. Chemical fertilizers applied by the inorganic farmers is 24.76 kgs. per acre, whereas the organic rice cultivating farmers used 458.47 kgs. of organic manure for cultivation. The t-test result shows a significant difference of 18.48 kgs. per acre between organic and inorganic rice for organic manure and chemical fertilizers. On an average 1.27 kgs. of indigenous pesticides are used to spray for protecting rice crops by both farmers groups, but its use is less by inorganic farmers (i.e., 0.71 kg.).

Irrigation cost is observed to be higher for organic farmers (Rs. 1262) than for the inorganic farmers (Rs. 1188) per acre. But the t-value estimated to see the input use difference between the two varieties of rice shows insignificant difference. It is observed that the producers of inorganic rice variety obtained an output of 3370.93 kgs. per acre, whereas that of organic rice variety yielded only 2014.77 kgs. per acre. It shows a significant difference of 1356.16 kgs. per acre between the yields of the two varieties. This difference emerges highly significant.

Among all the inputs, the highest and significant difference is found for fertilizer (chemical for inorganic and organic manure for organic rice varieties). Next, the output shows a significant difference between the two varieties. The analysis shows an evidence of a definite superiority of inorganic rice variety over organic rice in terms of the average yield acquired per acre.

Table – 4.3.2 shows the average input and output structure per acre for organic and inorganic rice varieties by different farm size.

TABLE- 4.3.2
INPUT AND OUTPUT STRUCTURE PER ACRE BY FARM SIZE: ORGANIC AND INORGANIC RICE VARIETIES

Sl. No.	Particulars	Unit	Small Farm Size	Medium Farm Size	Difference	t-value (S.F. vs M.F)
A.	**Naga Special Rice Variety (Organic)**					
1.	Seeds	Kg.	18.09	18.05	0.04	0.01
2.	Bullock labour	Pair	02	02	0.00	-
3.	Human labour	Man-days	178	179	-1.00	0.07
4.	Chemical fertilizer/Organic manure	Kg.	467.36	449.57	17.79	0.59
5.	Pesticides	Kg.	1.54	1.00	0.54	0.34
6.	Irrigation Cost	Rs.	1220	1302	-82.00	1.64
7.	Yield	Kg.	2014.50	2015.10	-0.60	0.01
8.	Sample Size	-	50	50	0.00	-
B.	**Ranjit Rice Variety (Inorganic)**					
1.	Seeds	Kg.	18.26	17.98	0.28	0.05
2.	Bullock labour	Pair	02	02	0.00	-
3.	Human labour	Man-days	120	118	2.00	0.16
4.	Chemical fertilizer/Organic manure	Kg.	24.65	24.86	-0.21	0.03
5.	Pesticides	Kg.	0.95	0.51	0.44	0.37
6.	Irrigation Cost	Rs.	1210	1164	46.00	0.95
7.	Yield	Kg.	3331.30	3404.60	-73.30	0.89
8.	Sample Size	-	112	138	-26.00	-

Note: S.F. = Small Farm; and M.F. = Medium Farm.

For organic rice, the average quantity of seeds used by small farmers is 18.09 kgs. and for medium farmers it is 18.05 kgs. The bullock labour pair hired is found to be similar for the small farmers and the medium farmers (i.e., two pairs per acre each). The average number of mandays employed by the small farmer is 178 per acre, while it is 179 mandays for the medium farmers. Small farmers applied 467.36 kgs. of organic manure and medium farmers used 449.57 kgs. per acre. Both small and medium farmers use indigenous pesticides to protect plant, which is observed to be more for small farmers (i.e., 1.54 kg. per acre) than for the medium farmers (1.0 kg. per acre).

The average irrigation cost is observed to be higher by Rs. 82 for medium farmers (Rs. 1302) than the small farmers (Rs. 1220). The output yield is higher for medium farmers (2015.10 kgs.) than for the small organic rice farmers (2014.50 kgs.). It shows a difference of 0.60 kgs. of rice yield per acre between the two farm size. The t-test calculated to examine whether differences exist in inputs used and output between the two group of rice farmers, shows it to be insignificant, implying no significant differences in inputs used and output obtained across the farm size for organic rice cultivation, though the inputs used like seeds and organic manure is more.

As for inorganic rice farming, it is observed that application of inputs like seeds (18.26 kgs. and 17.98 kgs.), pesticides (0.95 kg. and 0.51 kg.), irrigation cost (Rs. 1210 and Rs. 1164) and human labour (120 and 118 man days) per acre is more for the small farmers compared to the medium farmers. However, the input like chemical fertilizer is observed to be used more by medium farmers than the small farmers. The output yielded per acre is also higher for medium farmers (3404.60 kgs.) than for the small farmers (3331.30 kgs.). But, the t-test calculated shows no significant difference between inputs and output between the two farm size for inorganic rice cultivation.

To sum up, the levels of most of the input application is observed to be higher for small farmers for both organic and inorganic rice cultivation. The cause for more intensive use of inputs by small farmers is because they are cultivating it for domestic consumption purposes, unlike the medium farmers who also cultivate it for commercial purpose. However, the output yield is found to be higher for the medium farmers under both the rice varieties. This result is supported by the findings of Deolalikar (1981)[1], who observed that large farmers would have higher productivity than small farmers given a higher level of agricultural technology.

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[1] A. B. Deolalikar, "The Inverse Relationship between Productivity and Farm Size: A Test Using Regional Data from India", *American Journal of Agricultural Economics,* Vol. 63, No. 2, 1981, pp. 275-279, Accessed on 17/12/2013.

4.4 Labour Requirements

This part of the chapter gives detailed information on the number and cost of employing male and female labour for both organic and inorganic rice cultivation. The farm activities involved in rice cultivation are broadly classified under eight sub-headings: (1) land preparation, (2) sowing and transplanting, (3) application of chemical fertilizer or organic manure, (4) plant protection measures, (5) weeding, (6) harvesting, (7) irrigation, and (8) threshing.

The average number of male and female labour (hired and family labour) employed and the expenditure incurred on them per acre for both rice varieties are given in table - 4.4.1.

TABLE- 4.4.1
FARM ACTIVITIES-WISE AVERAGE LABOUR REQUIRMENTS PER ACRE: ORGANIC AND INORGANIC RICE VARIETIES

Sl. No.	Farm Activities	M.L.	F.L.	T.L.	M.L.C.	F.L.C.	T.L.C.
A.	**Organic Rice Variety**						
1.	Land preparatory activity	3.7 (1.91)	2.8 (1.8)	6.5 (3.71)	740	560	1298
2.	Sowing and transplanting	2.58 (1.81)	2.44 (0.77)	5.02 (2.58)	516	488	1004
3.	Application of organic manure	1.00 (1)	0.50 (0.50)	1.50 (1.50)	200	100	300
4.	Plant protection measures	1.50 (1.50)	-	1.50 (1.50)	300	-	300
5.	Weeding	-	11.45 (2.58)	11.45 (2.58)	-	2290	2290
6.	Irrigation	6.31 (5.18)	-	6.31 (5.18)	1262	-	1262
7.	Harvesting	13.4 (4.45)	6.4 (1.6)	19.80 (6.05)	2680	1280	3960
8.	Threshing	4.76 (1.59)	2.01 (2.01)	6.77 (3.6)	952	402	1354
	Total	33.25 (17.44)	25.60 (9.26)	58.85 (26.70)	6650	5120	11770
B.	**Inorganic Rice Variety**						
1.	Land preparatory activity	7.12 (2.73)	3.13 (1.34)	10.25 (4.07)	1424	626	2050
2.	Sowing and transplanting	2.27 (0)	6.59 (3.77)	8.66 (3.77)	454	1318	1772
3.	Application of inorganic fertilizers	1.00 (0)	1.00 (0)	2.00 (0)	200	200	400
4.	Plant protection measures	2.00 (0)	-	2.00 (0)	400	-	400
5.	Weeding	-	12.62 (3.79)	12.62 (3.79)	-	2524	2524
6.	Irrigation	5.94 (1.77)	-	5.94 (1.77)	1188	-	1188
7.	Harvesting	15.04 (0.82)	8.73 (3.16)	23.77 (3.98)	3008	1746	4754
8.	Threshing	5.01 (2.02)	2.07 (0)	7.08 (2.02)	1002	414	1416
	Total	38.38 (8.34)	34.14 (12.06)	72.52 (20.40)	7676	6828	14505

Note: M.L. = Male Labour; F.L. = Female Labour; M.L.C. = Male Labour Cost; F.L.C. = Female Labour Cost; and bracket shows family labour.

The organic rice growers incurred a total labour cost of Rs. 11,770 on about 59 labourers (both hired and family labours). Whereas, the inorganic farmers incurred a total labour cost of Rs. 14504 on employing approximately 73 labourers. The table indicates that the cultivators of inorganic rice employ relatively more number of labourers and thus incur higher labour cost. Of all the farm activities, the highest number of labourers are employed for harvesting by both the rice cultivators (20 for organic and 24 for inorganic rice cultivation). It is also observed that in the case of organic rice cultivation, 46 percent of the total labour employed are family labourers, whereas for inorganic rice cultivation, it is only 29 percent of the total labour employed, and the rest are all hired labour. The composition of male and female labour employment shows that for all farm activities for both the rice varieties farming, both male and female labourers are employed, except for weeding, where only female labourers are employed by both the types of rice farmers. This result is supported by the results of Unnevehr and Stanford[2] and Aiyasamy, Rajagopalan and Sundaresan[3]. It is also observed that for both rice varieties farming, for plant protection activity and irrigation only male labourers are employed by both the organic and inorganic farmers.

The average labour requirements and cost incurred across different farm size for organic rice farming is illustrated in table – 4.4.2.

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[2] L. J. Unnevehr and M.L. Standford, *Technology and the Demand for Women's Labour in Asian Rice Farming*, Paper presented at the Conference on Women in Rice Farming Systems, International Rice Research Institute, September 26-30, 1983, p. 2, Accessed on 17/12/2013.

[3] P. K., Aiyasamy, V. Rajagopalan and R. Sundarsan, "Economic Appraisal of Pattern of Labour Utilisation in Different Tracts of Tamil Nadu", *Southern Economic Review,* Vol. 5, No. 1, 1975, pp. 31-49, Accessed on 12/09/2013.

TABLE – 4.4.2
ACTIVITIES-WISE AVERAGE LABOUR REQUIRMENT PER ACRE BY FARM SIZE: ORGANIC RICE VARIETY

Sl. No.	Farm Activities	M.L.	F.L.	T.L.	M.L.C.	F.L.C.	T.L.C.
A.	**Small Farmers**						
1.	Land preparatory activity	3.7 (2.02)	2.68 (1.68)	6.38 (3.7)	740	536	1276
2.	Sowing and transplanting	2.58 (1.64)	2.66 (0.94)	5.24 (2.58)	516	532	1048
3.	Application of organic manure	1.00 (1)	0.50 (0.50)	1.50 (1.50)	200	100	300
4.	Plant protection measures	1.50 (1.50)	-	1.50 (1.50)	300	-	300
5.	Weeding	-	11.42 (2.58)	11.42 (2.58)	-	2284	2284
6.	Irrigation	6.1 (5)	-	6.1 (5)	1220	-	1220
7.	Harvesting	13.52 (4.64)	6.22 (1.42)	19.7 (6.06)	2704	1244	3948
8.	Threshing	5.26 (5.04)	2.00	7.26 (5.04)	1052	400	1452
	Total	33.66 (20.84)	25.48 (7.12)	59.14 (27.96)	6732	5096	11828
B.	**Medium Farmers**						
1.	Land preparatory activity	3.7 (1.8)	2.9 (1.9)	6.6 (3.7)	740	580	1320
2.	Sowing and transplanting	2.58 (1.98)	2.22 (0.6)	4.8 (2.58)	516	444	960
3.	Application of organic Manure	1.00 (1)	0.50 (0.50)	1.50 (1.50)	200	100	300
4.	Plant protection measures	1.50 (1.50)	-	1.50 (1.50)	300	-	300
5.	Weeding	-	11.48 (2.58)	11.48 (2.58)	-	2296	2296
6.	Irrigation	6.51 (5.31)	-	6.51 (5.35)	1302	-	1302
7.	Harvesting	13.28 (4.26)	6.62 (1.78)	19.9 (6.04)	2656	1324	3980
8.	Threshing	4.25 (4.15)	2.02	6.27 (4.15)	850	404	1254
	Total	32.82 (20)	25.74 (7.36)	58.56 (27.36)	6564	5148	11712

Note: M.L. = Male Labour; F.L. = Female Labour; M.L.C. = Male Labour Cost; F.L.C. = Female Labour Cost; and bracket shows family labour.

The comparative information on the average number of male and female labourers employed and cost incurred per acre by the small and medium farmer groups engaged in organic rice farming shows that the expenses on total labour employed for various farm activities are higher for small farmers. The total cost incurred is Rs. 11,828 for the small and Rs. 11,712 for medium farmers. Both small and medium farmers employ the highest number of labourers for harvesting activity (i.e., 20 labourers). For both the groups of farm size, the composition of male and female labourers is almost similar for activities like land preparation, sowing and transplanting, and applications of fertilizers and manure. However, for weeding activity, only female labourers are employed. It is also observed that for activities like plant protection activities, irrigation, harvesting and threshing, male labourers are employed more than female labourers.

Table – 4.4.3 illustrates the average labour requirement structure per acre of inorganic rice farming by farm size. The table gives detailed information on the labour cost incurred by the small and medium inorganic farmers by composition of male and female labourers.

TABLE – 4.4.3

ACTIVITIES –WISE AVERAGE LABOUR REQUIRMENTS PER ACRE BY FARM SIZE: INORGANIC RICE VARIETY

Sl. No.	Farm Activities	M.L.	F.L.	T.L.	M.L.C.	F.L.C.	T.L.C.
A.	**Small Farmers**						
1.	Land preparatory activity	6.94 (2.46)	3.24 (1.35)	10.2 (3.81)	1388	648	2036
2.	Sowing and transplanting	2.27 (0)	6.59 (3.78)	9.16 (3.78)	454	1318	1772
3.	Application of inorganic fertilizers	1.00 (0)	1.00 (0)	2.00 (0)	200	200	400
4.	Plant protection measures	2.00 (0)	-	2.00 (0)	400	-	400
5.	Weeding	-	12.61 (3.79)	12.61 (3.79)	-	2522	2522
6.	Irrigation	6.05 (1.75)	-	6.05 (1.75)	1210	-	1210
7.	Harvesting	14.84 (2.14)	8.9 (1.64)	23.73 (3.78)	2968	1780	4748
8.	Threshing	5.02 (0)	2.14 (2.04)	7.16 (2.04)	1004	428	1432
	Total	38.12 (6.35)	34.48 (12.60)	72.91 (18.95)	7624	6896	14520
B.	**Medium Farmers**						
1.	Land preparatory activity	7.29 (3.02)	3.42 (1.32)	10.71 (4.34)	1458	684	2142
2.	Sowing and transplanting	2.27 (0)	6.59 (3.76)	8.86 (3.76)	454	1318	1772
3.	Application of inorganic fertilizers	1.00 (0)	1.00 (0)	2.00 (0)	200	200	400
4.	Plant protection measures	2.00 (0)	-	2.00 (0)	400	-	400
4	Weeding	-	12.62 (3.78)	12.62 (3.78)	-	2524	2524
5.	Irrigation	5.82 (1.78)	-	5.82 (1.78)	1164	-	1164
6.	Harvesting	15.23 (2.81)	8.55 (0.96)	23.78 (3.77)	3046	1710	4756
7.	Threshing	5 (0)	2 (2)	7 (2)	1000	400	1400
	Total	38.61 (7.61)	38.18 (11.82)	72.34 (19.43)	7722	7636	15358

Note: M.L. = Male Labour; F.L. = Female Labour; M.L.C. = Male Labour Cost; F.L.C. = Female Labour Cost; and bracket shows family labour.

Under inorganic farming, the total cost incurred on employing labour is observed to be higher for medium farmers (i.e., Rs. 15,358) than for the small farmers (i.e., Rs. 14,520), unlike for the organic rice farming. The ratio of male and female labourers employed under inorganic farmers is almost similar for all the activities, except for weeding, irrigation, plant protection activities and harvesting activities for both the farm size groups. Under both organic and inorganic rice farming, majority of the hired labourers are involved in harvesting activity. Most of the family labourers are involved in irrigation (for organic) and land preparing activity (for inorganic rice). In all the activities, male labourers play the major role, except for weeding activity. But for inorganic rice cultivation, female labourers are dominant in two activities, namely weeding as well as sowing and transplanting. It is observed that there is no wage discrimination between male and female labourers, i.e., they are paid Rs. 200 per day, unlike the observation made by Subramaniyan[4] in his study where females are noticed to have been paid relatively lower wages than the males. Compared to organic rice farming, inorganic cultivators hired more labour for the farm activities, whereas organic cultivators employed more of the family labourers. In general, rice cultivation is observed to be quite labour intensive.

4.5 Cost and Return Structure

In agriculture, the cost and return relationship plays a very vital role. Cost of cultivation can be defined as the expenditures on inputs incurred by a farmer to achieve the final output. The cost incurred by a farmer is of two types – a) variable/ operational cost and b) fixed cost. Variable cost is the cost incurred by a farmer on factors of production such as seeds, human labour, fertilizers, pesticides, bullock labour, livestock feed, tractor fuel, etc. Fixed cost is the cost incurred on rent, taxes, depreciation of implements and machinery, interest, insurance premium, etc. (Nirmala, 1992)[5].

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[4] G. Subramaniyan, "Labour Demand and Supply Responsiveness of Cotton in Madurai District", *Indian Journal of Agricultural Economics,* Vol. 41, No. 2, April-June, 1986, pp. 155-163, Accessed on 12/10/2013.

[5] V. Nirmala, "Economic Analysis of Rice Cultivation: A Study of Tamil Nadu", Concept Publishing Company, New Delhi, pp. 55-58, Accessed on 12/09/2013.

The cost and return structure of both the organic and inorganic rice cultivation per acre is given in table – 4.5.1.

TABLE – 4.5.1
COST AND RETURN STRUCTURE PER ACRE: ORGANIC AND INORGANIC RICE VARIETIES

Sl. No.	Cost Components	Organic Farmers		Inorganic Farmers		Difference	t-value (O.R vs I.R)
		Value in Rs.	%	Value in Rs.	%		
1.	Human labour (including family labour)	11770	46.01	14504	52.41	-2734	16.87*
2.	Bullock labour	343.10	01.34	319.54	01.16	23.56	0.92
3.	Chemical fertilizer / organic manure	1583.10	06.19	2364.50	8.54	-781.40	12.44*
4.	Pesticides	887.25	3.47	494.82	1.79	392.43	10.56*
5.	Seeds cost	361.48	01.41	277.50	01.00	83.98	3.32*
6.	Irrigation cost	1262	4.93	1188	04.72	74	1.49
7.	Interest on working capital	926.5	03.74	858.6	03.10	67.90	2.23**
Cost A		**17133.43**	**66.97**	**20006.96**	**72.29**	**-2873.53**	**-**
8.	Interest on fixed capital, excluding land revenue and depreciation of implements and machinery	2451.15	9.58	2669.55	9.65	-218.40	3.05*
9.	Imputed rent on lar	6000	23.45	5000	18.07	1000	12.91*
Cost C (Total)		**25584.58**	**100**	**27676.51**	**100**	**-2091.93**	**-**
Yield per Acre in Kg.		2014.77		3370.93		-1356.16	18.48*
Yield per Acre in Rs.		20262		32615.50		-12353.50	53.72*
Net Income per Acre in		3128.57		12608.54		-9479.97	-

Note: O.R. = Organic Rice; I.R. = Inorganic Rice; % = Percentage; and * indicate significance at one percent level and ** indicates significance at five percent level.

The table shows that the total variable cost (Cost A) is observed to be higher for inorganic rice farmers (Rs. 20,006.96) as compared to the organic farmers (Rs. 17,133.43). When looked into each input costs in particular, human labour cost (which includes family labour too), fertilizer cost and interest on fixed capital are observed to be more for inorganic farmers. However, bullock labour cost, seeds cost, irrigation cost, interest on working capital, and imputed rent on land are observed to be more for the organic farmers.

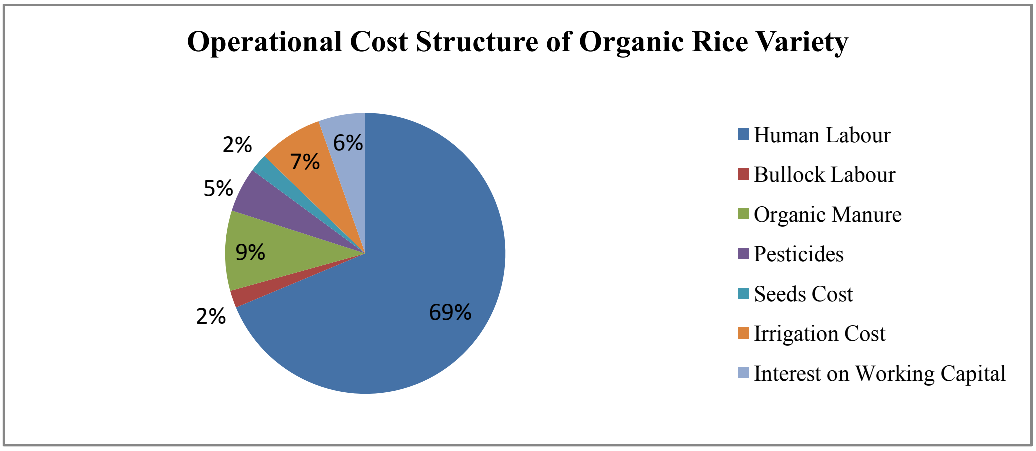
For both the rice varieties, expenditure on human labour accounted for a major share of the total cost (46.01 % for organic rice variety and 52.41% for inorganic rice variety), followed by rent, which constituted 23.45 percent for organic rice variety and 18.07 percent for inorganic rice variety. After these two inputs incurring the major cost share, were chemical fertilizer and manure cost, irrigation cost and other inputs. The inorganic rice variety yielded 3370.93 kg. of rice per acre, bringing in a revenue of Rs. 32,615.50. The total variable cost incurred was Rs. 20,006.96, leading to a net income of Rs. 12,608.54 per acre. On the other hand, the organic rice variety yielded 2014.77 kg. of rice per acre and earned a revenue of only Rs. 20,262. However, the total variable cost incurred was Rs. 17,133.43 and the net income received was only Rs. 3128.57. For both organic and inorganic rice cultivation, the operational cost is observed to form around 66 and 72 percent of the total cost for organic and inorganic rice cultivation respectively. Except for the use of bullock labour and irrigation cost, all the other inputs use differed significantly between the two varieties

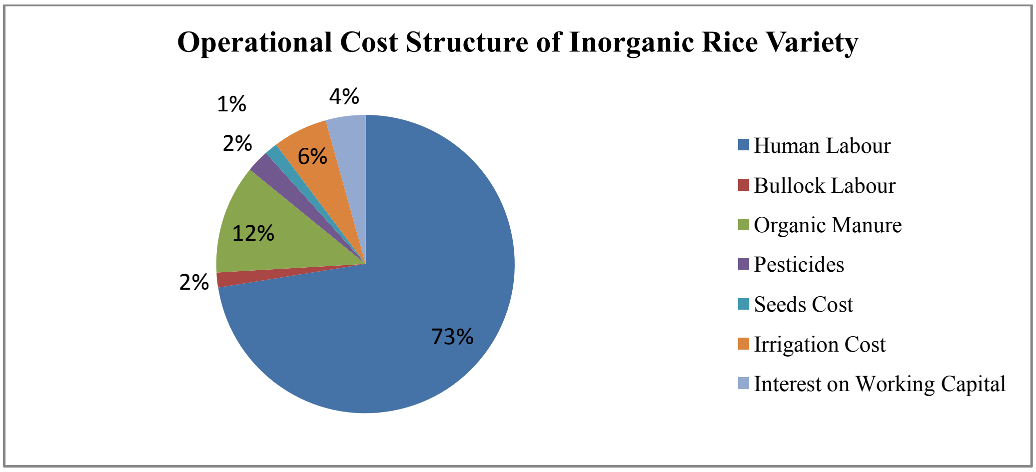
Thus, inorganic rice variety has performed better than the organic rice variety in terms of both total yield and profit earned per acre. This finding is contradicted by the result of Nghia and Dzung[6], where they concluded that organic rice variety performed better than conventional rice variety.

The operational cost structures of organic and inorganic rice varieties are picturised in Figure - 1.

[6] Nguyen Thi Ai Nghia and Pham Tien Dzung, "Research and Promotion of Organic Rice Production in Hanoi, Vietnam", *International Journal of Agriculture Innovations and Research,* Vol. 4, No. 5, 2016, p. 947.

FIGURE –1
COST STRUCTURE OF ORGANIC AND INORGANIC RICE VARIETIES





The cost structure shows that for both the rice varieties, expenditure on human total labour constitutes the major cost, which is similar to the findings of Adhikari[7] and Nghia and Dzung[8].

Detailed information on the average cost and return structure per acre of the small farmers and medium farmers cultivating organic rice variety is presented in table – 4.5.2.

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[7] Raj K. Adhikari, "Economics of Organic Rice Production", *The Journal Of Agriculture And Environment,* Vol. 12, No. 1, June 2011, p.100.

[8] Nghia and Dzung, loc. cit.

TABLE – 4.5.2
COST AND RETURN STRUCTURE PER ACRE OF ORGANIC RICE BY FARM SIZE

Sl. No.	Cost Components	Small Farmers		Medium Farmers		Difference	t-value (S.F vs M.F)
		Value in Rs.	%	Value in Rs.	%		
1.	Human labour (including family labour)	11828	45.89	11712	50.18	116	0.78
2.	Bullock labour	576.66	2.24	109.54	0.47	467.12	17.83*
3.	Organic manure	1440.4	5.59	1725.8	7.40	-285.40	5.07*
4.	Pesticides	1074.5	4.17	700	2.99	375.50	8.89*
5.	Seeds Cost	361.89	1.41	360.97	1.55	0.92	0.04
6.	Irrigation cost	1220	4.73	1302	5.58	-82	-1.64***
7.	Interest on working capital	887	3.44	916	3.93	-29	0.68
Cost A		**17388.45**	**67.46**	**16826.31**	**72.09**	**562.14**	**-**
8.	Interest on fixed capital excluding, land revenue and depreciation of implements and machinery	3887.6	15.08	1014.7	4.35	2872.90	41.03*
9.	Imputed rent on land	4500	17.46	5500	23.56	-1000	10*
Cost C (Total)		**25776.05**	**100**	**23341.01**	**100**	**2435.04**	**-**
Yield per Acre in Kg.		2014.50		2015.10		-0.60	0.01
Yield per Acre in Rs.		19483		21041		-1558	7.74*
Net Income per Acre in Rs.		2094.55		4214.69		-2120.14	-

Note: S.F. = Small Farmers; M.F. = Medium Farmers; % = Percentage; and * indicates significant at one percent level and *** indicates significant at ten percent level.

The total variable cost incurred by the small farmers (i.e., Rs. 17,388.45) is more than the amount spent by the medium farmers (i.e., Rs. 16,826.31). Expenditure on inputs for organic rice cultivation shows that for small farmers the variable cost forms around 67.46 percent of the total cost. However for medium farmers, the variable cost comes around 72.09 percent. For both the farm size categories, human labour constitutes the major cost component (46 % for small farmers and 50% for medium farmers) which is similar to the result reported by Harrison[9]. Rent is observed as the next important item of expenditure for the both the farm size (17.46% and 23.56% respectively). The expenditure on bullock labour, organic manure, pesticides, irrigation cost, interest on fixed capital and rent differed significantly between the two farms size. The difference in bullock labour cost may be due to the ownership of bullock pair by the small farmers. The difference in pesticides cost arises out of the greater plant protection measures taken by the small farmers to protect plant. Finally, the rent differences exists probably due to the existence of imperfect land market in the village. The per acre monetary returns and the net returns differ significantly between the small and medium farmers for organic rice. Small farmers yielded a physical output of 2014.50 kgs. per acre with a monetary return of Rs. 19,483 per acre, and earned a net return of Rs. 2094.55 per acre. On the other hand, the quantity of rice harvested by medium farmers is 2015.10 kgs. per acre, which is 1558 kgs. more than the small farmers and a monetary return of Rs. 21,041 per acre.

The analysis thus indicated that although small farmers incurred a higher cost of cultivation, medium farmers obtained higher net return which is supported by the result of Nirmala[10]. This result may be due to the better credit position, storage and other facilities of the medium farmers that has enabled them to wait for the maximum price of their produce and earn more profit.

The cost of inputs and returns obtained by small and medium farmers cultivating inorganic rice variety is highlighted in table – 4.5.3

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[9] James Quigley Harrison, Agricultural Modernization and Income Distribution: An Economic Analysis of the Impact of New Seed Varieties in the Crop Production of Large and Small Farms in India, (mimeo), Ph.D., Princeton University, 1972, Accessed on 16/04/2013.

[10] Nirmala, op. cit. p. 98.

TABLE – 4.5.3
COST AND RETURN STRUCTURE PER ACRE OF INORGANIC RICE BY FARM SIZE

Sl. No.	Cost Components	Small Farmers		Medium Farmers		Difference	t-value (S.F vs M.F)
		Value in Rs.	%	Value in Rs.	%		
1.	Human Labour (including Family Labour)	14577.6	51.44	14619.1	53.65	-41.50	12.73*
2.	Bullock Labour	475.34	1.68	193.09	0.71	282.25	10.92*
3.	Chemical Fertilizer	2367	8.35	2362	8.67	05	0.08
4.	Pesticides	665	2.35	356.70	1.31	308.30	9.65*
5.	Seeds Cost	273.85	0.97	269.67	0.99	04.18	0.18
6.	Irrigation cost	1210	4.27	1164	4.27	46	0.95***
7.	Interest on working capital	833.5	2.94	883.7	3.24	-50.20	1.21
Cost A		**20402.29**	**71.99**	**19848.26**	**72.84**	**554.03**	**-**
8.	Interest on fixed capital excluding land revenue and depreciation of implements and machinery	3438.90	12.13	1900.20	6.97	1538.70	21.06*
9.	Imputed rent on land	4500	15.88	5500	20.19	-1000	10*
Cost C (Total)		**28341.19**	**100**	**27248.46**	**100**	**1092.73**	**-**
Yield per Acre in Kg.		3331.30		3404.60		-73.30	0.89
Yield per Acre in Rs.		31079		34152		-3073	12.03*
Net Income per Acre in Rs.		10676.71		14303.74		-3627.03	-

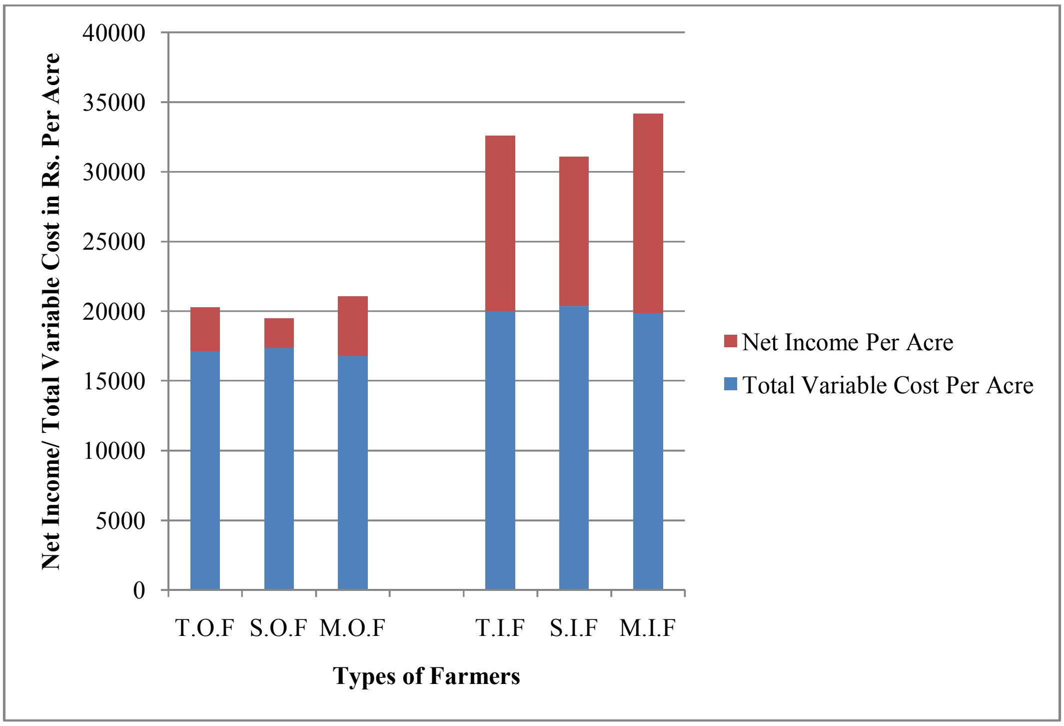
Note: S.F. = Small Farmers; M.F. = Medium Farmers; % = Percentage; and * indicates significant at one percent level and *** indicates significant at ten percent level.

The input cost exhibits almost similar pattern in both the farms. Variable cost formed about 72 percent of the total cost for both farms and expenditure. Human labour constitutes the major cost, followed by rent for both the farms. The table shows that like the organic rice cultivation, per acre monetary returns and the net returns for inorganic farmers differ significantly between the small and medium farmers. Among the inputs, human labour cost, bullock labour cost, pesticides cost, irrigation cost, interest on fixed capital and rent also differed significantly between the two farmer categories.

Small farmers yielded a physical output of 3331.30 kgs., a monetary return of Rs. 31,079 per acre and earned a net return of Rs. 10,676.71. On the other hand, the quantity of rice harvested by medium farmers was 3404.60 kgs. (which was 73.3 kgs. more than the small farmers) and a monetary return of Rs. 34,152 per acre. The total variable cost incurred by the small farmers (i.e., Rs. 20,402.29) is more than the amount spent by the medium farmers (i.e., Rs. 19,848.26). Thus, this indicates that small farmers had incurred a higher cost of cultivation, and obtained a higher net return under inorganic rice cultivation.

The cost and return structure of organic and inorganic rice varieties by farm size has been illustrated in figure – 2.

FIGURE – 2
COST AND RETURN STRUCTURE OF ORGANIC AND INORGANIC FARMERS



Note: T.O.F. – Total Organic Farmers; S.O.F. – up to Small Organic Farmers; M.O.F. – Medium Organic Farmers; T.I.F. - Total Inorganic Farmers; S.I.F. – up to Small Inorganic Farmers; M.I.F. – Medium Inorganic Farmers.

The figure clearly shows that the inorganic farmers earn more net return per acre than the organic farmers. Further, for both the rice varieties, medium farmers enjoy more net returns than the small farmers.

Thus from the tables and figure it can be concluded that medium farmers yielded more output in terms of kgs. and earned more income, as compared to the small farmers for both the rice varieties. This finding is supported by the studies of Cornia[11], and Nehring, et. al.[12] However, it has also been observed that the input cost for both rice varieties is more for small farmers as compared to medium farmers.

4.6 Relationship between Farm Size and Efficiency

The article published by Sen (1962)[13] was one of the earliest attempts to study the relationship between farm size and productivity. However, several economists concluded that the inverse relationship remains 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 the rapid technological changes and the expansion of commercial farming have changed the whole assumption toward small farming's efficiencies. And thus, as the agricultural sector has moved towards modernization through the adoption of more capital intensive technology, the inverse relationship has diminished.

The relationship between the farm-size and efficiency have been examined in terms of land, labour, average variable cost and average total cost across the two rice varieties and their farm size. For the analysis, the given model has been estimated in log form:-

$$\ln DEPVA_i = \alpha + \beta \ln ACRES + \varepsilon$$

[11] G. A. Cornia, "Farm Size, Land Yields and the Agricultural Production Function: An analysis for Fifteen Developing Countries", *World Development,* Vol. 13, No. 4, 1985, pp. 513-534, Accessed on 16/04/2013.

[12] Rechard Nehring, Jeffrey Gillespie, Charlie Hallahan and Johannes Saver, "The Economics and Productivity of Organic Versus Non-Organic U.S. Dairy Farms", Paper presented at the Southern Agricultural Economics Association Annual Meeting, Atlanta, February 4-7, 2015, pp. 1-16, Accessed on 04/03/2015.

[13] A. K. Sen, "An Aspect of Indian Agriculture", *Economic Weekly*, Vol. 1, No. 14, 1962, pp. 4-6, Accessed on 17/09/2013.

where,

$DEPVA_i$ = the dependent variables; where i = 1,...,4.

1 = yield per acre in Kg.;

2 = labour man days per acre;

3 = average variable cost per acre in Rs.;

4 = average total cost per acre in Rs.;

ACRES = the total cultivated land; and

ε = the error term.

Table 4.6.1 presents the regression results of the estimated relationship between farm size and the dependent variables like output, average variable cost, average total cost and labour man days per acre for both organic and inorganic farmers.

TABLE – 4.6.1
FARM SIZE - EFFICIENCY RELATIONSHIP BY RICE VARIETIES

Dependent Variable	Independent Variable	Coefficient	R^2	F-Value
A) Organic Rice Variety				
Output per acre	Farm size	0.01 (2.91)*	0.07	8.46*
Labour per acre	Farm size	-0.66 (8.94)*	0.44	79.89*
Average Variable Cost per acre	Farm size	-0.09 (7.54)*	0.37	56.88*
Average Total Cost per acre	Farm size	-0.19 (15.10)*	0.70	228.09*
B) Inorganic Rice				
Output per acre	Farm size	0.01 (1.13)	0.01	1.28
Labour per acre	Farm size	-0.15 (11.37)*	0.34	129.22*
Average Variable Cost per acre	Farm size	-0.05 (3.85)*	0.06	14.78*
Average Total Cost per acre	Farm size	-0.14 (10.85)*	0.32	117.74*

Note: *- significance at one percent level; and bracket shows the t-value.

For organic rice variety, the relationship between farm size and land productivity is observed to be positive and significant at one percent level for organic farmers, implying that an increase in acres of land being used for cultivation increases the output produced per acre. This finding is contradictory to Sen (1962[14], 1966[15]) who observed an inverse relationship between farm size and output per hectare in Indian agriculture. But Cornia (1985)[16], Deolalikar (1981)[17] and Bhandari (2006)[18] found a positive relationship between farm-size and productivity, thus supporting the result of the present study. However, a negative and significant relation is found between farm size and labour used per acre, and input cost per acre (average variable cost and average total cost), indicating a significant decrease in labour productivity and cost per acre as farm size increases.

The relationship between farm size and productivity for inorganic farmers shows a positive but insignificant relationship, whereas the relationship of farm size with labour per acre, and input cost per acre (average variable cost and average total cost) is again observed to be negative and significant. The decrease in labour productivity in response to increase in farm size reflects the operation law of diminishing returns. The decrease in costs (variable and total) implies the emergence of economics of scale with increase in farm size.

4.7 Market Channels

This section gives information on the market structure, which includes the purchasing sources of raw materials like seeds of different rice varieties and the sales channels of output for both the organic and inorganic rice farmers by farm size. The details are given in table 4.7.1.

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[14] Sen, loc. cit.

[15] A. K. Sen, "Size of Holdings and Productivity", *The Economic Weekly*, Annual No., Vol. XVI, Nos. 18, February 1964.

[16] Cornia, loc. cit.

[17] Deolalikar, loc. cit.

[18] R. Bhandari, "Searching for a Weapon of Mass Production in Nepal: Can Market Assisted Land Reforms Live Up to their Promise?", *Journal of Developing Societies,* Vol. 22, No. 1, 2006, pp. 111-143.

TABLE – 4.7.1
MARKET CHANNELS: ORGANIC AND INORGANIC RICE VARIETIES

Sl. No.	Particulars	Organic Farmers			Inorganic Farmers		
		Small Farmers	**Medium Farmers**	**Total**	**Small Farmers**	**Medium Farmers**	**Total**
A.	**Purchase of Raw Materials**						
1.	Local	20 (40)	30 (60)	50 (50)	67 (59.82)	58 (42.03)	125 (50)
2.	Agent	-	-	-	15 (13.39)	30 (21.74)	45 (18)
3.	Government outlet	30 (60)	20 (40)	50 (50)	30 (26.79)	50 (36.23)	80 (32)
4.	Others	-	-		-	-	-
	Total	**50 (100)**	**50 (100)**	**100 (100)**	**112 (100)**	**138 (100)**	**250 (100)**
B.	**Output Sale**						
1.	Consumer directly	30 (60)	12 (24)	42 (42)	-	-	-
2.	Agents	20 (40)	38 (76)	58 (58)	112 (100)	138 (100)	250 (100)
3.	Others	-	-	-	-	-	-
	Total	**50 (100)**	**50 (100)**	**100 (100)**	**112 (100)**	**138 (100)**	**250 (100)**

Note: Bracket shows percentages.

The table reveals that the producers of organic rice variety purchase raw materials for production activity from two main sources, i.e., local market and government outlet (50 % each). Majority of the small organic farmers (60%) purchase raw materials from the government outlet, whereas most of the medium farmers (60%) use local market. In the case of inorganic rice farmers, majority of them use local market for purchasing raw materials (50%), which is followed by government outlet (32%) and the private agents (18%). The same trend is observed for both the small and medium inorganic farmers.

The second part of the table gives information on the market channel for selling their output. Majority of both the organic (58%) and all inorganic farmers (100%) sell their output to the private agents. The main cause for this behaviour may be due to the absence of proper regulated market. Few of the organic farmers (42%) are observed to be selling their output to the consumer directly. Organic small rice farmers sell their output mainly to consumers directly (60%), whereas the medium farmers mostly sell it to agents (76%).

Thus, it can be concluded from the table that the agriculture market structure of the study area lacks proper market facilities, which is the basic necessity for any cultivator to prosper, like regulated market, government intervention or the wholesalers.

4.8 Debt Details

The debt details of both the organic and inorganic rice farmers are presented in table – 4.8.1.

This table shows that out of total 350 farmers, 131 (37.43%) took loan and 219 (62.57%) did not. Out of the 131 farmers, 62 percent were organic rice farmers and 27.6 percent inorganic farmers. Most of the total 64 farmers (48.86%) have taken loan from their friends, (53.2% organic farmers and 44.9% inorganic farmers). Period of loan shows that out of the 131 farmers, for majority (43.51%) it was one year. So was for the inorganic farmers (44.9 %) and organic farmers (41.9%). But for the organic farmers, majority (53.2%) had taken loan for two years.

Out of the total farmers, 33.59 percent (majority) had taken loan at five percent interest rate, followed by three percent interest rate (32.06%). Among the organic farmers also majority (58.1%) had taken loan at five percent interest rate, followed by three percent interest rate (35.5%) and four percent (only 6.5 %). Whereas among the inorganic farmers, majority (29%) had taken loan at three percent interest rate, followed by eight percent interest by 27.5 percent farmers, and six percent interest rate by 15.9 percent farmers.

TABLE – 4.8.1
DEBT DETAILS: ORGANIC AND INORGANIC FARMERS

Sl. No.	Details	Organic Farmers (%)	Inorganic Farmers (%)	Total (%)
A.	**Debts Taken:**			
	Yes	62 (62)	69 (27.6)	131 (37.43)
	No	38 (38)	181 (72.4)	219 (62.57)
	Total	**100 (100)**	**250 (100)**	**350 (100)**
B.	**Source of Debt:**			
	Bank	-	19 (27.5)	19 (14.51)
	Friends	33 (53.2)	31 (44.9)	64 (48.86)
	Employer	10 (16.1)	0	10 (7.64)
	Relative	19 (30.6)	19 (27.5)	38 (29.01)
	Total	**62 (100)**	**69 (100)**	**131(100)**
C.	**Period of Loan:**			
	6 months	-	11 (15.9)	11 (8.39)
	1 year	26 (41.9)	31 (44.9)	57 (43.51)
	2 years	33 (53.2)	8 (11.6)	41 (31.29)
	3 years	3 (4.8)	11 (15.9)	14 (10.69)
	5 years	-	8 (11.6)	8 (6.11)
	Total	**62 (100)**	**69 (100)**	**131 (100)**
D.	**Rate of Interest (in percent) Per Annum:**			
	3	22 (35.5)	20 (29)	42 (32.06)
	4	4 (6.5)	-	4 (3.05)
	5	36 (58.1)	8 (11.6)	44 (33.59)
	6	-	11 (15.9)	11 (8.39)
	8	-	19 (27.5)	19 (14.51)
	Total	**62 (100)**	**69 (100)**	**131 (100)**
E.	**Mode of Repayment:**			
	1. Monthly	27 (43.5)	30 (43.5)	57 (43.51)
	2. Annually	2 (3.2)	11 (15.9)	13 (9.93)
	3. Whenever income received	33 (53.2)	28 (40.6)	61 (46.57)
	Total	**62 (100)**	**69 (100)**	**131(100)**

Note: Bracket shows percentages.

Mode of repayment shows that whenever the farmers received income, 61 (46.57%) repaid loans. It was repaid on monthly basis by 57 farmers (43.51%) and annually by 13 farmers (9.93%). The same pattern is observed for both organic and inorganic farmers by farm size.

4.9 Accessibility of Extension Services

The accessibility to extension services of both the organic and inorganic rice farmers are shown in table – 4.9.1.

TABLE – 4.9.1
ACCESSIBILITY TO EXTENSION SERVICES: ORGANIC AND INORGANIC FARMERS

Sl. No.	Particulars	Organic Farmers			Inorganic Farmers			All Farmers Total
		Small Farmers	Medium Famers	Total	Small Farmers	Medium Famers	Total	
1.	Yes	20 (40)	20 (40)	50 (50)	30 (26.79)	30 (21.74)	60 (24)	**110 (31.43)**
2.	No	30 (60)	30 (60)	50 (50)	82 (73.22)	108 (78.26)	190 (76)	**240 (68.57)**
Total		**50 (100)**	**50 (100)**	**50 (100)**	**112 (100)**	**138 (100)**	**250 (100)**	**350 (100)**

Note: Brackets show column-wise percentage.

This table clearly shows that out of the total 350 organic and inorganic rice farmers, majority of them (i.e., 240 farmers) have no access to extension services. In the case of total organic farmers, 50 percent have used the extension services provided. Majority of the medium organic farmers, i.e., 60 percent farmers have access to the extension services, whereas only 40 percent small farmers have access to the extension services.

On the other hand, it is observed that only 60 out of the 250 inorganic farmers (i.e., 24%) have been using the extension services provided to them, which means that most of the famers have no access to the extension services. The same behaviour is observed for both small (26.79%) and medium (21.74%) inorganic rice farmers.

CHAPTER – V

DETERMINANTS OF YIELD, YIELD GAP AND ITS CONSTRAINTS

In this chapter, an analysis of correlation and yield determinants is undertaken by rice varieties and farm size. It also looks into the yield gap between the two rice varieties (viz., Ranjit for inorganic and Naga Special for organic rice) by farm size to examine which variety yields relatively more output and which farmer group across farm size produces larger output. Further, a survey of the problems leading to yield gap is conducted to study the reasons for the yield gap.

A log linear production function has been used to estimate the factors determining the yields of the two rice varieties and by farm size. The yield function is fitted with yield as the dependent variable and inputs as the independent variables. The seven independent variables included in the regression model are as follows: (a) total labour mandays, (b) chemical fertilizer/ organic manure, (c) pesticides (d) capital flows, (e) irrigation cost, and (f) net return of the previous year. The latter has also been included as one of the independent variables, as it shows the economic incentive to the farmers to increase rice yield[1]. Further, farm size has been included as the seventh independent variable in the total farmers by variety regression, to analyse the impact of its change on yield.

The following log linear production function has been fitted to study the determinants of rice yield by varieties and farm size:-

$$\log YIELD_i = \beta_0 + \beta_1 \log LABOR + \beta_2 \log FRTZR + \beta_3 \log PESTD + \beta_4 \log KFLOW + \beta_5 \log IRRIG + \beta_6 \log NTRTN + \beta_7 \log FRMSZ + \mu$$

where,

$YIELD_i$ = yield/ output per acre in kg. of the two rice variety by farm size i (where, i = organic and inorganic small, medium and total rice farmers);

[1] Nirmala, V., *Economic Analysis of Rice Cultivation: A Study of Tamil Nadu*, Concept Publishing Company, New Delhi, 1992, p. 104.

LABOR = total labour mandays employed per acre;

FRTZR = chemical fertilizer/ organic manure per acre in kg.;

PESTD = pesticides per acre in kg.;

KFLOW= capital flows per acre in Rs.;

IRRIG = irrigation cost per acre in Rs.;

NTRTN = net return per acre in Rs.;

FRMSZ = farm size dummy (where, 1= small and 0= medium); and

μ = error term.

The combined farmers' regression model has been re-run by including farm size dummy variable, to analyse its influence on yield.

Further, Chow test (1960)[2] has been estimated to examine if structural difference exists between organic as well as inorganic rice yield determinants, as well as across small and medium farmers. The formula used is:-

$$F^{*} = \frac{\text{€}e^2 - (\text{€}e_1^2 + \text{€}e_2^2)/K}{(\text{€}e_1^2 + \text{€}e_2^2)/n_1+n_2 - 2K}$$

where,

K = number of parameters, including the intercept term;

$\text{€}e^2$ = unexplained sum of squares for total farmers;

$\text{€}e_1^2$ = unexplained sum of squares for farmer group one;

$\text{€}e_2^2$ = unexplained sum of squares for farmer group two; and

n_1+n_2 = total number of observations.

[2] Gregory C. Chow, "Tests of Equality between Sets of Coefficients in Two Linear Regressions", *Econometrica,* Vol. 28, No. 3, July 1960, pp. 591 – 605.

In addition, correlation matrix has been computed for the sets of variables included in the regression analysis to check if there is a chance of the emergence of multicollinearity problem in the estimation of the yield function.

5.1 Correlation Matrix

The correlation matrix for organic farmers by farm size and combined has been given in the table 5.1.1.

TABLE – 5.1.1
CORRELATION MATRIX: ORGANIC RICE FARMERS

Farm Size	Variables	YIELD	LABOR	FRTZR	PESTD	IRRIG	NTRTN	KFLOW
Small Farmers	YIELD	1						
	LABOR	0.111	1					
	FRTZR	0.096	-0.059	1				
	PESTD	0.119	0.073	0.050	1			
	IRRIG	-0.032	0.021	-0.015	-0.062	1		
	NTRTN	-0.396*	-0.357**	0.130	-0.040	0.045	1	
	KFLOW	-0.385*	-0.209	0.033	0.001	0.029	0.739*	1
Medium Farmers	YIELD	1						
	LABOR	0.618*	1					
	FRTZR	0.056	-0.176	1				
	PESTD	-0.188	-0.079	0.241	1			
	IRRIG	0.023	0.148	-0.085	0.013	1		
	NTRTN	0.771*	0.617*	0.070	-0.046	0.064	1	
	KFLOW	-0.611*	-0.588*	0.169	0.109	-0.080	-0.766*	1
Combined	YIELD	1						
	LABOR	0.422*	1					
	FRTZR	0.066	-0.124	1				
	PESTD	-0.019	-0.015	0.134	1			
	IRRIG	0.005	0.087	-0.088	-0.448*	1		
	NTRTN	-0.140	-0.228**	0.102	0.068	-0.079	1	
	KFLOW	-0.224**	-0.211**	0.094	0.423*	-0.456*	0.621*	1

Note: * and ** indicate significance at one and five percent levels respectively.

The table shows that under organic rice farming, inputs like human labour and capital flow shows a significant correlation with yield at one and five percent level. In the case of both the small and medium organic farmers, inputs like capital flow and net return are significantly correlated with yield at one percent level. It is observed that the input human labour has a significant positive correlation to the dependent variable yield. Over-all, the degree of correlation is slightly higher between capital flows and irrigation cost in the case of all farmer categories. In the case of the medium farmers, it is again slightly on the higher side between yield and labour mandays, capital flows and net returns, besides labour and net returns. This is likely to cause multicollinearity problem in the estimation of the yield function.

Table 5.1.2 illustrates the correlation matrix for inorganic rice farmers by farm size and combined farmers.

TABLE – 5.1.2
CORRELATION MATRIX: INORGANIC RICE FARMERS

Farm Size	**Variables**	YIELD	LABOR	FRTZR	PESTD	IRRIG	NTRTN	KFLOW
Small Farmers	YIELD	1						
	LABOR	-0.354*	1					
	FRTZR	0.311*	-0.147	1				
	PESTD	-0.025	-0.027	0.026	1			
	IRRIG	-0.008	0.042	-0.002	-0.012	1		
	NTRTN	0.076	-0.068	-0.100	-0.113	-0.170	1	
	KFLOW	0.458*	0.055	0.232**	-0.041	0.030	-0.539*	1
Medium Farmers	YIELD	1						
	LABOR	0.220*	1					
	FRTZR	-0.013	0.306*	1				
	PESTD	-0.026	-0.118	-0.092	1			
	IRRIG	-0.047	0.055	0.043	-0.173**	1		
	NTRTN	0.033	-0.312*	-0.071	0.012	-0.079	1	
	KFLOW	-0.065	0.200**	-0.061	-0.019	-0.003	-0.552*	1
Combined	YIELD	1						
	LABOR	-0.128**	1					
	FRTZR	0.269*	0.099	1				
	PESTD	-0.318*	0.061	-0.131**	1			
	IRRIG	-0.209*	0.091	-0.075	0.388*	1		
	NTRTN	0.253*	-0.230*	0.020	-0.464*	-0.368*	1	
	KFLOW	0.012	0.173*	-0.014	0.429*	0.298*	-0.681*	1

Note: * and ** indicates significance at one and five percent levels respectively.

Under inorganic rice farming all the six inputs, except capital flow shows a significant correlation with the yield. For inorganic small farmers, independent variables human labour, fertilizer and capital flow are significantly correlated with the yield at one percent level. However, for inorganic medium farmers only the variable human labour shows a positive significant correlation with yield. The matrix also shows that of all the six inputs for the combined inorganic farmers, inputs like fertilizer and net return are positively correlated to yield. Over-all, only in the case of capital flows and net returns the degree of correlation seems to be slightly higher. In sum, since not many variables are strongly correlated to cause serious multicollinearity problem in the estimation of the yield function, all variables have been included in the regression estimation.

5.2 Determinants of Yield

This part of the chapter gives discusses the factors determining yield of both the rice varieties by farm size. Table 5.2.1 presents the results of estimated yield function for organic rice by farm size.

TABLE- 5.2.1
REGRSSION RESULTS: YIELD FUNCTION – ORGANIC FARMERS

Sl. No.	Variables	Combined		Small Farmers	Medium Farmers
		Model - I	Model - II		
1.	Constant	7.482 (0.00)*	7.433 (0.00)*	7.660 (0.00)*	6.746 (0.00)*
2.	LABOR	0.076 (0.00)*	0.058 (0.01)*	-0.008 (0.72)	0.082 (0.04)**
3.	FRTZR	0.009 (0.17)	0.009 (0.12)	0.006 (0.37)	0.007 (0.37)
4.	PESTD	0.003 (0.59)	-0.002 (0.76)	0.005 (0.31)	-0.013 (0.10)***
5.	KFLOW	-0.008 (0.00)*	-0.018 (0.00)*	-0.007 (0.05)**	-0.002 (0.75)
6.	IRRIG	-0.037 (0.09)***	-0.006 (0.78)	0.002 (0.92)	-0.032 (0.46)
7.	NTRTN	0.001 (0.64)	0.001 (0.45)	-0.001 (0.12)	0.070 (0.00)*
8.	FRMSZ	-	-0.024 (0.00)*	-	-
	R^2	0.27	0.38	0.25	0.67
	F-Value	5.81*	7.94*	2.35**	14.41*

Note: Bracket shows the p-value; and *, ** and *** indicates significance at one, five and 10 percent levels respectively.

The analysis shows that in the case of total organic farmers, under the first model, all the six explanatory variables jointly cause 27 percent of the variations in yield. Variables human labour, fertilizer, pesticides and net return have a positive impact on yield. However, only human labour has a significant effect. On the other hand, capital flows and irrigation cost are negatively and significantly related to the dependent variable. Human labour is the most influential factor, indicating that employing more human labour contributes to increased rice yield. The second model also shows similar result. Here, farm size in acre also has a negative and significant effect on yield, implying emergence of diseconomies of scale Together the included independent variables explain about 38 percent of the variability in yield. This model also reveals that human labour is the most influential factor contributing to increased rice yield. One percent increase in the input human labour results in 0.058 percent increase in yield. The other important determinants of yield are capital flow and farm size, which show a negative and significant impact on yield. It indicates that increased capital flows and farm size lower yield by 0.018 and 0.24 percentages. The overall regression model emerges significant at one percent level for both the models.

In case of the small farmers, the study reveals that 25 percent of the variations in yield are caused jointly by the six independent variables. However, of all the six variables, only capital flow has negative and statistically significant (at five percent level) influence, indicating that one percent increase in capital flows would decrease the yield by 0.007 percent. Although fertilizer, pesticides and irrigation show a positive impact on rice yield, their impacts are statistically insignificant. The regression model for organic small farmers is found to be significant at five percent level.

As far as the medium farmers are concerned, all the six variables together explain around 67 percent of the variation in yield. Of all the independent variables, human labour, pesticides and net return have a significant influence. Pesticides have a negative significant impact on the dependent variable, while the other two have positive effects. Net returns and human labour are found to be the most influential factors, indicating that one percent increase in net returns and human labour result in

0.070 and 0.082 percent increase in the yield respectively. Finally, the regression model for the medium farmers emerges statistically significant at one percent level.

The results of yield function for inorganic farmers by farm size is shown in table 5.2.2.

TABLE- 5.2.2
REGRSSION RESULTS: YIELD FUNCTION – INORGANIC FARMERS

Sl. No.	Variables	Combined		Small Farmers	Medium Farmers
		Model - I	Model - II		
1.	Constant	7.025 (0.00)*	6.820 (0.00)*	6.890 (0.00)*	8.371 (0.00)*
2.	LABOR	-0.033 (0.02)**	-0.034 (0.02)**	-0.166 (0.00)*	0.021 (0.01)*
3.	FRTZR	0.295 (0.00)*	0.266 (0.00)*	0.221(0.03)**	-0.061 (0.20)
4.	PESTD	-0.025 (0.00)*	0.001 (0.89)	0.006 (0.54)	-0.003 (0.83)
5.	KFLOW	-0.024 (0.22)	0.004 (0.85)	0.068 (0.00)*	-0.006 (0.06)***
6.	IRRIG	0.033 (0.00)*	0.036 (0.00)*	0.019 (0.53)	-0.010 (0.49)
7.	NTRTN	0.019 (0.00)*	0.029 (0.00)*	0.066 (0.00)*	-0.003 (0.73)
8.	FRMSZ	-	0.031(0.00)*	-	-
	R^2	0.23	0.29	0.45	0.08
	F-Value	11.90*	14.19*	14.12*	1.80***

Note: Bracket shows the p-value; and *, ** and *** indicates significance at 1, 5 and 10 percent levels respectively.

The analysis reveals that all input variables together cause about 23 percent of variations in the yield of inorganic rice in the case of first model. Except the capital flow, rest of the variables show a significant impact on the dependent variable. Only increased human labour and pesticides use have negative and significant decreasing effect on yield by 0.033 and 0.025 percent respectively. Of the remaining significant variables, fertilizers shows the highest positive impact on yield, i.e., one percent increase in fertilizer results in 0.295 percent increase in yield. Net returns significantly increases yield by 0.019 percent. Increased irrigation significantly increases yield by 0.033 percent. The regression result of the second model (which includes farm size as one of the independent variables) reveals that all the seven variables together cause about 29 percent of variations in yield. In this case, while human labour has significant negative impact on yield, increased fertilizer use, irrigation, net returns and farm size have positive and significant effect. Thus, inorganic rice cultivation proves to be input intensive. Both the regression models are statistically significant at one percent level.

In the case of small farmers for inorganic farming, all the six inputs together cause about 45 percent of the variations in yield. Inputs like fertilizer, capital flow and net return have a positive and significant impact on yield. But the variable human labour shows a negative significant impact on yield. Of all the three significant inputs, fertilizer proves to be the most influential factor, followed by capital flow and net return. The regression model for inorganic small farmers is statistically significant at one percent level.

The analysis for the inorganic medium farmers reveals that all the six independent variables together cause only eight percent of the variations in yield. Of all the six variables, only human labour has a positive and significant impact on yield, whereas capital flow has a negative significant impact. This model is found to be statistically significant at 10 percent level.

Thus, it is observed that inputs like fertilizer, pesticides and net return, which show insignificant effects in regression results for organic combined model, are also found to be insignificantly correlated with yield. When studied by farm size, the result shows that effects of fertilizer and irrigation cost are found to be insignificant in the regression analysis for both the small and medium organic farmers, which are also observed to be insignificantly correlated with the yield. In the case of inorganic farmers, capital flows is observed to be the only insignificant variable in the regression model, which is also found to be insignificant in the correlation matrix with yield. Small inorganic farmers' regression results also show that variables like pesticides and irrigation cost are insignificant, which are also insignificantly correlated to yield. Finally, inputs fertilizer, pesticides, irrigation and net return show an insignificant result for both regression as well as correlation model.

In general, to sum up, it is observed that human labour though has a significant effect on yields of both the rice varieties, it has a positive impact on yield of all organic farmer groups. However in the case of inorganic farmers, human labour employed has a negative impact which might be due to the existence of disguised unemployment, where the labour may be seemingly employed but are not wholly productive[3]. All the regression tables under both organic and inorganic type of farming and for both small and medium farmers show that human labour and fertilizers have the highest influence over the yield. Unlike organic type of farming, under inorganic farming human labour has a negative significant impact on yield per acre, which might be the result of disguised unemployment which is very prominent in agriculture. Irrigation cost is observed to have a negative significant impact on the yield for organic total farmers. However for inorganic total farmers, irrigation cost has a positive significant impact, which is again observed to have a negative impact for inorganic medium farmers. Thus, it can be concluded that improper irrigation management can lead to wet soil, damage crop and reduce yields, which is supported by the result of Irmak (2014)[4]. In order to enhance the productivity of rain fed agriculture, rainfall has to be used more effectively through proper water management like Supplemental Irrigation[5], where the amount of water added is decided according to the rainfall of that season, which will improve the productivity of irrigation as well as rain water.

Chow test is used to find whether structural difference exists between the determinants of organic and inorganic rice yields. Its result is shown in table 5.2.3.

[3] A. K. Dasgupta, "Disguised Unemployment and Economic Development", *Economic Weekly*, Vol. VIII, No. 34, August 25, 1956, p. 1, Accessed on 16/03/2015.

[4] Suat Irmak, "Plant Growth and Yield as Affected by Wet Soil Conditions Due to Flooding or Over-Irrigation", Neb Guide, UniveRs.ity of Nebraska – Lincoln Extension, Institute of Agriculture and National Resources, G1904, Lincoln, United States of America, April, 2014, pp. 1-4, Accessed on 23/03/2015.

[5] Theib Oweis and Ahmed Hachum, "Optimizing Supplemental Irrigation: Trade Offs between Profitability and Sustainability", *Agricultural Water Management,* Vol. 96, No. 3, 2009, pp. 511-516, Accessed on 23/03/2015.

TABLE- 5.2.3
STRUCTURAL DIFFERENCE IN YIELDS OF ORGANIC AND INORGANIC RICE FARMERS

$€e^2$	$€e_1^2$	$€e_2^2$	$n_1+n_2 - 2K$	F^*	F(6,338) at 5% level	Inference
42.69	4.11	0.18	338	493.08	2.19	There is structural difference between organic and inorganic farmers.

The result of Chow test shows that the computed F-value (493.08) exceeds the table F-value (2.19), and therefore the result is significant at five percent significance level. Thus it is concluded that there is existence of structural difference between the factors influencing the yields of organic and inorganic rice varieties.

Table 5.2.4 shows the Chow test results used to find out the existence of structural difference between the determinants of yields of the small and medium organic rice farmers.

TABLE- 5.2.4
STRUCTURAL DIFFERENCE IN YIELDS OF ORGANIC SMALL AND MEDIUM RICE FARMERS

$€e^2$	$€e_1^2$	$€e_2^2$	$n_1+n_2 - 2K$	F^*	F(6,88) at 5% level	Inference
4.11	1.52	0.26	88	19.38	2.20	There is structural difference between small and medium farmers under organic type of farming.

The Chow test result shows that the computed F-value (19.38) exceeds the table F-value (2.20), and hence the result is significant at five percent significance level. Thus, it can be concluded that there is existence of structural difference between the determinants of yields of the organic small and medium farmers.

The Chow test results of the analysis of existence of structural difference between yields of small and medium farmers under inorganic rice farming is given in table 5.2.5.

TABLE- 5.2.5
STRUCTURAL DIFFERENCE IN YIELDS OF INORGANIC SMALL AND MEDIUM RICE FARMERS

$€e^2$	$€e_1^2$	$€e_2^2$	$n_1+n_2 - 2K$	F^*	F(6,238) at 5% level	Inference
0.18	0.07	0.03	238	32.5	2.19	There is structural difference between small and medium farmers under inorganic type of farming.

The analysis clearly shows that the computed F-value (i.e., 32.50) exceeds that critical F-value (i.e., 2.19). Thus, it is concluded that structural difference exists between the yields of small and medium farmers under inorganic farming.

5.3 Yield Gap and its Constraints

Yield potential (Yp), also called potential yield is the yield of a crop cultivator when grown with water and nutrients non-limiting, and biotic stress effectively controlled (Van Ittersum and Rabbinge, 1997).[6] Average yield (Ya) is defined as the yield actually achieved in a farmer's field. The yield gap (Yg) is the difference between potential yield (Yp) and actual yields (Ya).

There are two different ways of defining the concept of yield gap. First is to calculate the difference between the experiment station yield to the potential farm yield, which is called yield gap-I. The second is to find the difference between potential farm yield and actual average farm yield called yield gap-II (Nirmala, 1992)[7].

In the present study, the Yield Gap I and II of the two rice varieties organic (Naga Special Rice) and inorganic (Ranjit) by farm size are estimated. Yield Gap-I is the difference between experiment station yield (Ye) and the farm level potential yield

[6] M. K. Van Ittersum and R. Rabbinge, "Concepts in Production Ecology for Analysis and Quantification of Agricultural Input-ouput combinations", *Field Crops Research,* Vol. 52, No. 1, 1997, pp. 197-208.

[7] Nirmala, op.cit., p. 63.

(Yp). Whereas the difference between the potential/ maximum yield (Yp) and the actual/ average yield (Ya) is defined as Yield Gap-II.

Table 5.3.1 gives detailed information of the experimental station's input and output structure and the net returns for both the rice varieties (organic and inorganic).

TABLE – 5.3.1
EXPERIMENTAL STATION INPUT-OUTPUT STRUCTURE AND RETURNS PER ACRE BY RICE VARIETIES

Sl. No.	Particulars	Unit	Organic Rice	Inorganic Rice
1.	Seeds	Kg.	20	20
2.	Human labour	Mandays	120	100
3.	Chemical fertilizers/ organic manure	Kg.	141	30
4.	Pesticides	Kg.	0.93	.90
5.	Irrigation cost	Rs.	1500	1500
Total cost		Rs.	25,280	26,517
Yield		Kg.	2227	3500
Yield		Rs.	37,500	42,000
Net income		Rs.	12,220	15,483

The experimental station's input-output and returns structure of both the rice varieties has been clearly shown in the table. The average requirement of human labour in the experimental station for inorganic rice cultivation is about 100 mandays per acre, whereas for organic rice cultivation it is nearly 120 mandays per acre. Chemical fertilizers applied at the experimental station for inorganic cultivation is 30 kgs. per acre, and the organic manure applied is 141 kgs. per acre for organic cultivation. On an average 0.93 kgs. and 0.90 kgs. of pesticides per acre are used for protecting rice crops at the experimental station for organic and inorganic farming respectively. For both the types of farming, the average quantity of seeds used is 20 kgs. per acre. The irrigation cost is observed to be equal, i.e., Rs. 1500 per acre for both types of farming.

It is observed that the total cost incurred is higher for inorganic rice cultivation (Rs. 26,517) as compared to the organic rice cultivation (Rs. 25,280). The organic rice cultivation yielded 2227 kgs. of rice per acre, bringing in a revenue of Rs. 37,500 per acre, and a net income of Rs. 12,220. However, the inorganic rice cultivation yielded 3500 kgs. of rice per acre and earned a revenue of Rs. 42,000 per acre and net income of Rs. 15,483 per acre. Thus, indicating that the experimental station also proves inorganic farming to be more profitable as compared to the organic farming.

Table 5.3.2 gives the yield gap-I and II per acre for both organic and inorganic rice varieties.

TABLE – 5.3.2
PER ACRE YIELD GAP I AND II BY RICE VARIETIES

Sl. No.	**Details**	**Organic Rice**	**Inorganic Rice**
A.	**Yield Gap I**		
i)	Experimental station yield	2227 kgs.	3500 kgs.
ii)	Potential yield	2060 kgs.	3468 kgs.
	Yield gap	167 kgs.	32 kgs.
B.	**Yield Gap II**		
i)	Potential yield	2060 kgs.	3468 kgs.
ii)	Actual yield	2014.77 kgs.	3370.93 kgs.
	Yield gap	45.23 kgs.	97.07 kgs.

Yield gap-I gives the yield gap between the yield in the experimental station and the potential yield in the villages. Yield gap-I is observed to be higher for organic rice variety (167 kgs. per acre) as compared to the inorganic rice variety (only 32 kgs. per acre). However yield gap-II, which shows the yield gap between the potential (i.e., the maximum yield in the villages) and actual average yield obtained by the farmers, is observed to be higher for inorganic rice variety (97.07 kgs per acre) than for the organic rice variety (45.23 kgs per acre).

Table 5.3.3 gives the yield gap details of the two rice varieties by farm size.

TABLE – 5.3.3
PER ACRE YIELD GAP I AND II BY FARM SIZE

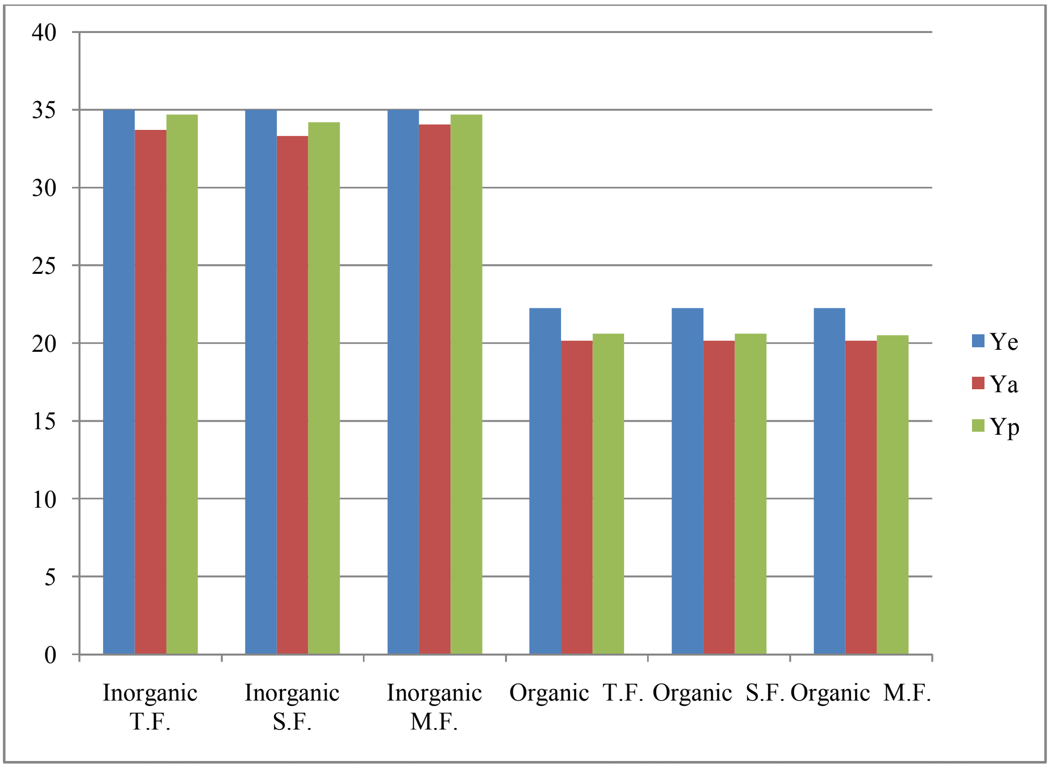
Sl. No.	Details	Small Farmers	Medium Farmers
A.	**Organic Rice Variety**		
1.	**Yield Gap I**		
i)	Experimental station yield	2227 kgs.	2227 kgs.
ii)	Potential yield	2016 kgs.	2051 kgs.
	Yield gap	211 kgs.	176 kgs.
2.	**Yield Gap II**		
i)	Potential yield	2016 kgs.	2051 kgs.
ii)	Actual yield	2014.50 kgs.	2015.10 kgs.
	Yield gap	1.50 kgs.	35.90 kgs.
B.	**Inorganic Rice Variety**		
1.	**Yield Gap I**		
i)	Experimental station yield	3500 kgs.	3500 kgs.
ii)	Potential yield	3420 kgs.	3468 kgs.
	Yield gap	80 kgs.	32 kgs.
2.	**Yield Gap II**		
i)	Potential yield	3420 kgs.	3468 kgs.
ii)	Actual yield	3331.30 kgs.	3404.60 kgs.
	Yield gap	88.70 kgs.	63.40 kgs.

Yield gap for organic rice variety when studied from the farm size point of view, shows that yield gap-I is observed to be higher for small farmers (211 kgs. per acre) as compared to the medium farmers (176 kgs. per acre). Whereas, yield gap-II is observed to be higher for medium organic farmers (35.90 kgs. per acre) than for the small farmers (1.50 kgs. per acre).

In the case of inorganic rice variety, both yield gap-I and II are observed to be higher for small farmers, i.e., 80 kgs. per acre for yield gap-I and 88.70 kgs. per acre for yield gap-II. Yield gap-I and II for medium inorganic farmers are observed to be 32 kgs. per acre and 63.40 kgs. per acre respectively.

The yield gap analysis is explained clearly by figure - 1.

FIGURE – 1
YIELD GAP OF INORGANIC AND ORGANIC RICE VARIETIES BY FARM SIZE



Note: Ye = Yield in Experimental Station; Yp = Potential Yield (or Maximum Farm Yield); Ya = Actual Yield (or Average Farm Yield); T.F. = Total Farmer; S.F. = Small Farmer; and M.F. = Medium Farmer.

The figure diagrammatically projects yield gap-I, that is the yield gap among the yield in experimental station and potential (maximum) yield in the villages, for both organic (Naga Special) and inorganic (Ranjit) rice varieties in Nagaland. Though all the farmers aims to reap maximum yield, not all can attain the potential yield reaped at the experimental station. As for the present study, the figure clearly shows that experimental station yield for organic rice variety (Naga Special) was 2227 kgs. of rice per acre and for inorganic rice variety (Ranjit), it was 3500 kgs. However the potential yield for organic rice variety was 2060 kgs. per acre and for Inorganic rice variety was 3468 kgs. per acre. Thus, it led to a yield gap-I of 167 kgs. per acre for organic rice variety and 32 kgs. per acre for inorganic rice variety.

In the case of the organic rice variety, the maximum farm-level yield reaped was 2060 kilograms per acre, while the average of yield reaped was 2014.77

kilograms per acre. This resulted in a yield gap- II of 45.23 kilograms per acre. However for inorganic rice variety, the maximum farm-level yield reaped was 3468 kilograms per acre, while the average of yield reaped was 3370.93 kilograms per acre. And this caused in a yield gap- II of 97.07 kilograms per acre.

From the farm size point of view, the figure clearly reveals that in the case of organic rice variety, yield gap-I is observed to be higher for small farmers (211 kgs. per acre). However, yield gap-II is found to be higher for medium farmers as compared to the former (i.e., 35.90 kgs. per acre). In the case of inorganic rice variety, it has been observed that small farmers have higher gap under both yield gap I and II.

Garrett ranking technique (1969)[8] has been used to identify the main constraints to achieving potential yield in the two villages. The respondents ranked the constraints faced by them according to priority. Then, the order of merit assigned to each constraint ranked by the respondent was converted into ranks by using the following formula:

$$\text{Per Cent Position} = \frac{100\,(R_{ij} - 0.5)}{N_j}$$

where,

R_{ij} = rank given by the j^{th} individual for the i^{th} factor; and

N_j = number of factors ranked by the j^{th} individual.

The percent position of the ranks are converted into scores using Garrett's ranking table. Then, the scores of all farmers are added for each reason and divided by the number of farmers who have responded, to obtain the mean score. The mean scores are arranged in descending order and ranks assigned to each reason.

Table – 5.3.4 illustrates the ranks given based on the priority assigned to different reasons for yield gap by both organic and inorganic farmers. For organic farmers, of the total 100 respondents, only 70 had ranked the reasons, and of 250 inorganic farmers, 242 had ranked the reasons for yield gap.

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[8] Henry E. Garrett and R. S. Woodworth, *Statistics in Psychology and Education*, Vakils, Feffer and Simons Private Ltd., Bombay, 1969, p. 329.

TABLE – 5.3.4
RANKINGS OF REASONS FOR YIELD CONSTRAINTS BY ORGANIC AND INORGANIC FARMERS

Sl. No.	Reasons	Organic Farmers			Inorganic Farmers		
		Total Score	Mean Score	Rank	Total Score	Mean Score	Rank
A.	**Bio-Physical Factors**						
1.	Water control	5730	81.86	1	17781	73.48	1
2.	Soil fertility	3696	52.80	6	14347	59.29	6
3.	Problems of the soil	3938	56.26	5	14719	60.83	2
4.	Insects	5414	77.34	2	16753	69.23	3
5.	Weeds	4816	68.80	3	16748	69.21	4
6.	Variety	4410	63.00	4	15188	62.76	5
B.	**Socio-Economic Factors**						
7.	Cultural practices	3986	56.94	1	15110	62.44	1
8.	Credit	3056	43.66	3	11552	47.74	2
9.	Input availability	2894	41.34	4	10367	42.84	3
10.	Economic behaviour	2086	29.80	6	9473	39.15	4
11.	Risk aversion	3360	48.00	2	7877	32.55	7
12.	Knowledge	1904	27.20	7	8618	35.62	5
13.	Institutions	2414	34.49	5	7397	30.57	8
14.	Traditions	1226	17.52	8	8458	34.95	6

The table shows that among the bio-physical reasons for yield gap, water control is given the first rank by both organic and inorganic farmers. Second rank is given by the organic farmers to insect problems, followed by weeds, variety and then soil fertility. These same constraints of insects and water control have been ranked as the first important constraint in yield gap in a study of two rice varieties conducted in Gokilapuram village, Tamil Nadu (Nirmala 1992)[9]. Inorganic rice farmers gave

[9] Nirmala, op. cit., pp. 112-115.

second rank to problems of the soil, and third to insect problems, followed by weeds, variety and then soil fertility respectively.

The second part of the table shows ranks given to the socio-economic reasons of yield gap by both organic and inorganic farmers. It is observed that both the groups of farmers have ranked cultural practices as the first and the most important constraint in the yield gap. For the organic farmers the second rank is given to the risk aversion, which is ranked seventh by inorganic farmers. Credit, input availability, institutions, economic behaviour, knowledge and traditions are ranked third, fourth, fifth, sixth, seventh and eighth respectively by organic farmers and second, third, eight, fourth, fifth and sixth by the inorganic farmers respectively.

Thus, both the yield gap analysis shows the existence of difference between respective yields under both the rice varieties. However, the study shows that yield gap-I (i.e., the difference between the experimental station yield to the potential farm yield) is more for organic rice variety. Yield gap-I is caused mainly by factors that are generally not transferable, such as environmental conditions and some of the built-in component technologies that are available only at research stations. Therefore, generally it would be difficult to narrow down this gap.

However, in the case of yield gap-II (which is the gap between the potential farm yield and the actual farm yield), inorganic rice variety has been observed to have higher gap as compared to the organic rice variety. From the farm size point of view, yield gap-II is found to be higher for small farmers under the inorganic rice varieties. This yield gap-II is mainly caused by differences in management practices, cultural practices, and because of farmers' usage of sub-optimal doses of inputs. In the study, the main causes of the gap as ranked by the farmers are water control issues, pests, weeds, insects and cultural practices, which can be narrowed down by increasing efforts in research and extension services, as well as by appropriate government intervention, particularly in institutional issues.

To sum up, narrowing yield gaps will not only increase rice yield and production, but will also improve the efficiency of land and labour use, reduce production cost and increase sustainability. Thus, exploitable yield gaps in rice can be improved effectively only through adopting proper actions and through government's attention. The narrowing of the yield gap includes technological developments in rice production, because gaps tend to expand when the yield potential of rice varieties is improved[10].

Table – 5.3.5 highlights the cultivation problems faced by both the organic and inorganic rice farmers in the study area.

TABLE – 5.3.5

RANKINGS OF PROBLEMS OF ORGANIC AND INORGANIC FARMERS

Sl. No.	Problems	Organic Farmers			Inorganic Farmers		
		Total Score	Mean Score	Rank	Total Score	Mean Score	Rank
1.	Difficulty in getting raw materials	4460	44.60	8	7741	30.964	12
2.	Lack of transport facilities	6490	64.90	3	11479	45.916	7
3.	Lack of extension services	6210	62.10	4	8405	33.62	11
4.	Marketing problem	4740	47.40	7	14212	56.848	4
5.	Low price	7930	79.30	1	17209	68.836	1
6.	Low profit	7670	76.70	2	16616	66.464	2
7.	Loan not received in time	3330	33.30	11	11088	44.352	8
8.	High rate of interest	3715	37.15	10	10078	40.312	9
9.	Lack of irrigation water	5260	52.60	6	15359	61.436	3
10.	Labour problems	1955	19.55	12	9607	38.428	10
11.	Distance of market	3932	39.32	9	13190	52.76	5
12.	Insufficient yield	5625	56.25	5	12653	50.612	6

Both the organic and inorganic rice farmers ranked low price and low profit as the first and second major problems they face. Organic farmers gave third rank to lack of transport facilities, fourth to lack of extension services, fifth to insufficient yield, sixth to lack of irrigation water, seventh to marketing problem, eighth to difficulty in getting raw materials, ninth to distance of market, tenth to high rate of interest,

[10] www.rice2004.org, Accessed on 19/03/2015.

eleventh to loan not received in time and twelfth rank to labour problems. Whereas, in the case of inorganic rice farmers, the third rank was given to lack of irrigation water; fourth to marketing problem, fifth to distance of market, sixth to insufficient yield, seventh to lack of transport facilities, eighth to loan not received in time, ninth to high rate of interest, tenth to labour problems, eleventh to lack of extension services and twelfth rank to difficulty in getting raw materials.

Thus, it can be concluded from the study that of all the problems faced by both the groups of farmers, low price, low profit, lack of transport facilities, lack of extension services, lack of irrigation water and marketing problem are some of the major constraints behind the low productivity of the rice cultivation, especially for the organic rice cultivation.

CHAPTER – VI

INCOME INEQUALITIES AND DETERMINANTS OF CHOICE OF RICE CULTIVATION METHOD

This chapter attempts to study of the inequalities in net income distribution of the farmers cultivating the two rice varieties is conducted to assess which rice variety cultivation contributes to narrowing of income variations among the sample households. The major determinants of the farmers' choice of production method i.e., cultivating rice through organic or inorganic method have also been analyzed. Finally, a survey of the farmers' opinion on the environmental problems and issues are also conducted to find the reason for cultivating rice through organic method.

6.1 Income Inequalities

This part of the chapter examines the distribution of net income among the cultivators of organic (Naga Special) and inorganic (Ranjit) varieties of rice in the two villages, in Dimapur district, Nagaland, during kharif season 2013. In this study, inequality of income distribution refers only to the disparity in net income earned from rice cultivation. Lorenz curve and Gini ratio have been used to examine the inequalities in income distribution between the two rice varieties and farm size. F – test is used to examine whether they are significantly different.

Table 6.1.1 shows the net income distribution of the farmers by rice varieties.

TABLE – 6.1.1
NET INCOME DISTRIBUTION OF ORGANIC AND INORGANIC RICE FARMERS

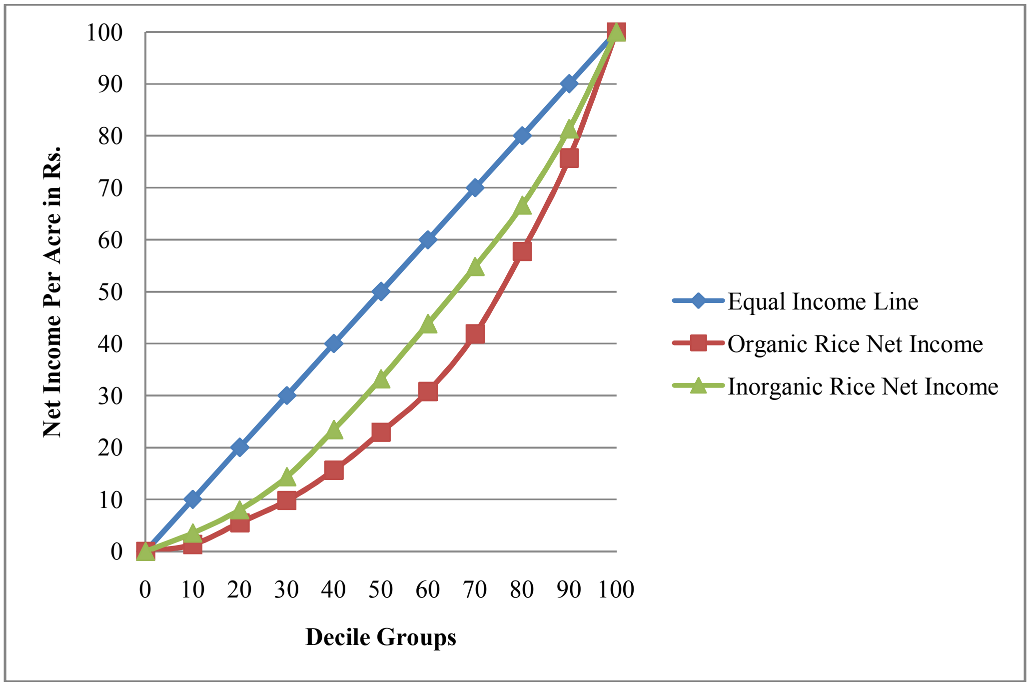
Decile Groups	Organic Farmers		Inorganic Farmers	
	Net Income Per Acre (Rs.)	Cumulative Percentages of Income	Net Income Per Acre (Rs.)	Cumulative Percentage s of Income
I	36960	1.30	93200	3.51
II	120000	5.51	119000	7.98
III	122000	9.80	168600	14.33
IV	165600	15.61	242000	23.43
V	208000	22.91	260000	33.21
VI	224400	30.78	281680	43.81
VII	316000	41.87	292600	54.82
VIII	452000	57.74	314400	66.65
IX	512000	75.71	389790	81.31
X	692000	100	496800	100
Gini Index	**37.76**		**24.19**	
Robin Hood Index	**29.22**		**16.79**	
F- Test	**1.31** (0.050)**			

Note: Bracket show p-value and ** indicate significant at 5 percent level.

In the case of organic rice cultivators, 70 per cent (decile groups I-VII) of the net income earners received only 41.87 per cent of the net income. The remaining 58.13 per cent of the net income has been earned by the top three earners (decile groups VIII-X. However in the case of the inorganic rice cultivators, the top four decile groups VII-X earned around 56.19 percent of the net income. The rest 43.81 per cent of the net income has been earned by 60 per cent of the income earners, i.e., decile groups I-VI. The Gini Index and Robin Hood Index results shows that considerable income inequality exists between the cultivators of the two rice varieties, which is observed to be more among the organic as compared to the inorganic farmers. The F-value calculated shows a significant difference between the two groups at five percent level, indicating that there is significant variation in the net incomes earned by the cultivators of the two rice varieties.

The Lorenz curves corresponding to the net income distribution pattern from organic and inorganic rice cultivation are shown in the figure - 1.

FIGURE – 1
LORENZ CURVES: NET INCOME DISTRIBUTION OF ORGANIC AND INORGANIC RICE FARMERS



In the figure, as the Lorenz curve of net income per acre for inorganic variety lies closer to the equal income diagonal and is above the organic rice income curve throughout, it may be inferred that there is a greater equality in the income distribution of the former than the latter variety cultivators.

Table 6.1.2 shows the net income distribution pattern of organic farmers by farm size.

TABLE – 6.1.2
NET INCOME DISTRIBUTION: ORGANIC RICE FARMERS BY FARM SIZE

Decile Groups	Small Farmers		Medium Farmers	
	Net Income Per Acre (Rs.)	Cumulative Percentages of Income	Net Income Per Acre (Rs.)	Cumulative Percentages of Income
I	36960	2.87	206000	5.01
II	36960	5.75	224400	10.47
III	100488	13.56	312000	18.06
IV	120000	22.88	316000	25.75
V	122000	32.37	354000	34.36
VI	122000	41.85	452000	45.36
VII	156000	53.97	510000	57.77
VIII	165600	66.84	514000	70.27
IX	210600	83.21	530000	83.17
X	216000	100	692000	100
Gini Index	**25.34**		**19.96**	
Robin Hood Index	**18.15**		**15.64**	
F- Test	**1.60** (0.050)**			

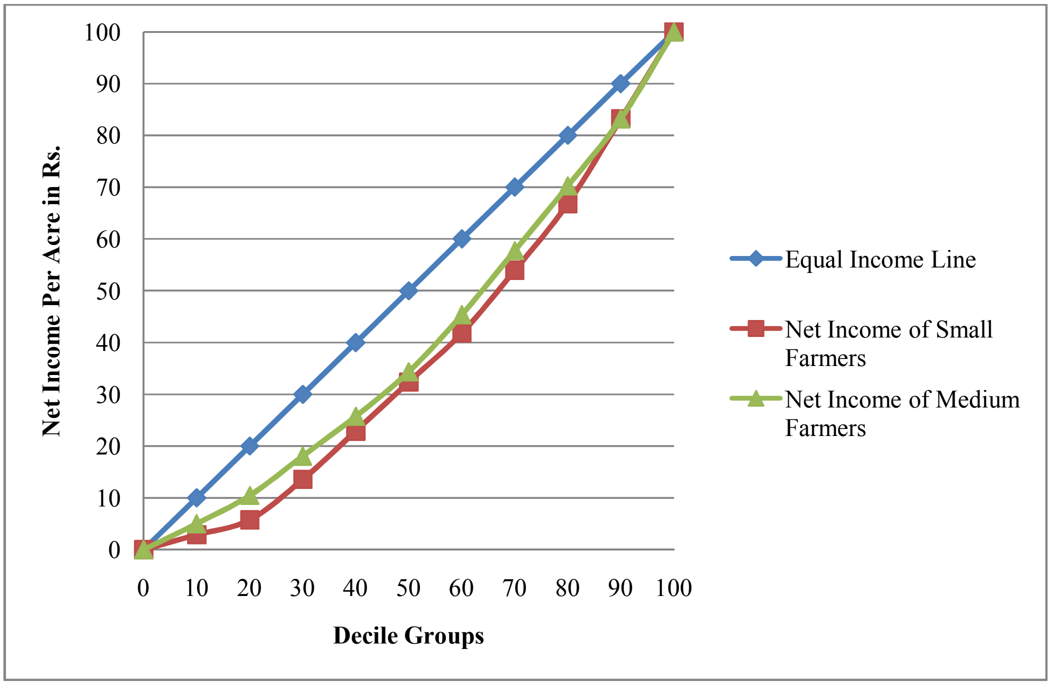
Note: Bracket show p-value; and ** indicates significance at five percent level.

Among the organic rice farmers, the income distribution pattern for both small and medium farmers is similar, i.e., more than 50 per cent of the net income has been enjoyed by the bottom four decile groups of farmers. The table clearly shows that the top 40 per cent (i.e., decile groups VII-X) of the small farmers cultivating organic rice variety enjoy the major portion of the net income, i.e., 58.15 per cent. Only 41.85 per cent of the net income has been earned by the remaining 60 percent of the cultivators.

The same pattern has been observed for medium farmers cultivating organic rice variety. Decile groups VII-X (40 percent) of the total farmers enjoy 54.64 per cent of the net income and the remaining 60 percent of the cultivators earn only 45.36 per cent of the total income. The Gini Index and Robin Hood Index analyses shows that the degree of inequality is higher among the small farmers. The F-value computed shows a significant difference at five percent level, proving variation in net income earned by the two groups of organic farmers.

The Lorenz curve for organic rice farmers, both small and medium farmers, is shown in figure – 2.

FIGURE – 2
LORENZ CURVES: NET INCOME DISTRIBUTION OF ORGANIC RICE FARMERS BY FARM SIZE



The Lorenz curve of net income per acre for small farmers cultivating organic rice variety has been observed to lie below that of the medium farmers, and thus lies farther away from the equal income line. Thus, it may be inferred that there is a greater inequality in the income distribution of small farmers than that of the medium farmers.

Net income distribution pattern of inorganic farmers by farm size has been presented in table – 6.1.3.

TABLE – 6.1.3
NET INCOME DISTRIBUTION: INORGANIC RICE FARMERS BY FARM SIZE

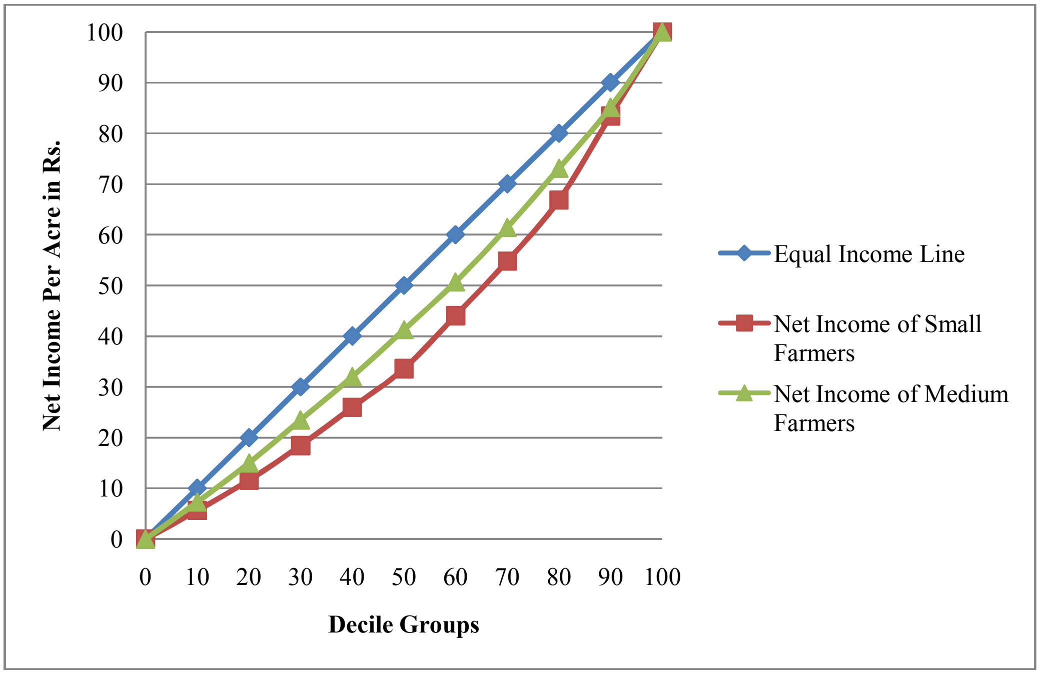
Decile Groups	Small Farmers		Medium Farmers	
	Net Income Per Acre (Rs.)	Cumulative Percentages of Income	Net Income Per Acre (Rs.)	Cumulative Percentages of Income
I	88320	5.64	242500	7.28
II	93200	11.58	256716	14.99
III	106880	18.41	281680	23.45
IV	119000	25.99	284580	31.99
V	119000	33.59	309400	41.28
VI	163700	44.04	314400	50.72
VII	168600	54.80	357000	61.44
VIII	188400	66.82	389790	73.14
IX	260000	83.41	397680	85.08
X	260000	100	496800	100
Gini Index	**21.15**		**12.12**	
Robin Hood Index	**16.41**		**9.28**	
F- Test	**1.34 ** (0.050)**			

Note: Bracket show p-value; and ** indicates significance at 5 percent level.

The table shows the pattern of distribution of net income among the small and medium farmers cultivating inorganic rice variety. Among the small farmers, a major portion of the net income, i.e., 55.96 per cent, has been earned by 40 per cent of the farmers (decile groups VII-X). However among the medium farmers, 58.72 per cent of the total income has been earned by 50 per cent of the farmers (decile groups VI-X). The Gini Index and Robin Hood Index results show that inequality in income distribution exists for the two groups of farmers, but is higher among the small farmers as compared to the medium farmers. The F-value computed shows that the income inequality is significant at five percent level, indicating variance between the two groups of farmers.

Figure – 3 shows the Lorenz curves of the income distribution of inorganic farmers for both the small and medium farmers.

FIGURE – 3
LORENZ CURVES: NET INCOME DISTRIBUTION OF INORGANIC RICE FARMERS BY FARM SIZE



The figure clearly reveals that the Lorenz curve of medium farmers lies closer to the equal income line and is above the small farmers' income curve. Thus, the figure indicates that the net income of the small farmers' is more unequally distributed than that of the medium farmers.

To conclude, income inequality is observed in net income of both organic and inorganic rice cultivators and between both small and medium farmers groups for both rice varieties cultivators. The Gini Index and Robin Hood Index results show that inequality is relatively greater among the organic rice farmers as compared to the inorganic farmers. When checked from the farm size perspective, under both rice varieties, income inequality is observed to be higher among the small farmers as compared to the medium farmers. Finally, the F - test results indicates that significant difference exists in the net income distribution of both the rice varieties cultivators as well as between both the farm size groups of farmers.

6.2 Determinants of Organic Rice Cultivation

This part of the chapter gives detail information of the factors determining the choice of cultivating rice by organic method. The following ordinary least squares

(OLS) regression model has been fitted to study the determinants of the farmers' choice of rice cultivation method. Although Logit regression would be a better model here, OLS regression model has been used as it yielded better result. The estimated choice of production method equation is of the following form:-

$$PRDCH = \alpha_0 + \alpha_1 logEDUFR + \alpha_2 logEXPFR + \alpha_3 logLNDON + \alpha_4 logPMKTS + \alpha_5 logNTRTN + \alpha_6 SEXFR + \alpha_7 MRTLS + \alpha_8 ATTDF + \mu$$

where,

PRDCH = farmers' production method choice, taking value zero for inorganic farming, and one for organic;

EDUFR = farmers' education in years;

EXPFR = farmers' rice cultivation experience in years;

LNDON = farmers' land ownership in acres;

PMKTS = percentage of marketable surplus out of the total output produced;

NTRTN = net returns per acre in Rs.,

SEXFR = farmers' sex, taking value one for female and zero for others;

MRTLS = farmers' marital status, taking value one for married and zero for others;

ATTDF = farmers' attitude towards use of agri-chemicals in rice cultivation;

FRMSZ = farm size in acres; and

μ = error term.

Table 6.2.1 presents the descriptive statistics of key variables used in the farmers' choice of rice cultivation method models.

TABLE – 6.2.1
DESCRIPTIVE STATISTICS: KEY VARIABLES

Sl. No.	Variables	Small Farmers			Medium Farmers			Total Farmers		
		Number	Mean	Standard Deviation	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation
1.	PRDCH	162	0.31	0.46	188	0.27	0.44	350	0.29	0.45
2.	EDUFR	162	9.76	2.05	188	10.56	2.47	350	10.19	2.31
3.	EXPFR	162	21.48	8.19	188	22.33	6.96	350	21.94	7.55
4.	LNDON	162	2.86	1.06	188	8.41	4.66	350	5.84	4.45
5.	PMKTS	162	93.14	13.75	188	90.99	16.19	350	91.98	15.12
6.	NTRTN	162	13217.98	11493.54	188	14651.83	7755.45	350	13988.16	9678.90
7.	SEXFR	162	0.08	0.26	188	0.15	0.36	350	0.12	0.31
8.	MRTLS	162	0.87	0.34	188	0.75	0.44	350	0.80	0.39
9.	ATTDF	162	-0.67	1.06	188	-0.79	1.08	350	-0.76	1.06

The analysis shows that the average educational level of the farmers are almost similar for small, medium and total farmers i.e., 9.76, 10.56 and 10.19 years respectively, and so is the standard deviation, which is observed to be 2.05, 2.47 and 2.31 for small, medium and total farmers respectively. The average experience received in years is observed to be 21.48 by small farmers, 22.33 by medium farmers and 21.94 by all the farmers together. In case of the acres of land owned, the average is 2.86 acres of land for small farmers, and for medium farmers it is observed to be 8.41 acres of land. For the total farmers, the average acres of land own is observed to be 5.84 acres of land.

Some variations in the average percentage of marketable surplus are observed i.e., 93.14 percent, 90.99 percent and 91.98 percent respectively for small, medium and total farmers. In case of the net return in Rs. the average return earned is found to be Rs. 13,217.98, Rs. 14,651.83 and Rs. 13, 988.16 for small, medium and total farmers respectively. The rest of the variables like sex, marital status and production method are dummy variables, however, it is observed that the mean for production method are 0.31, 0.27 and 0.29 for small, medium and total farmers respectively. In case of the variable 'attitude towards the use of agri-chemicals' the mean for both farm size groups and total farmers is observed to be negative.

Table 6.2.2 presents results of the linear regression function fitted to study the determinants of the farmers' choice of rice cultivation method.

TABLE -6.2.2
CHOICE OF RICE PRODUCTION METHOD REGRESSION RESULTS

Sl. No.	Variables	Total	Small Farmers	Medium Farmers
1.	Constant	0.437 (0.03)**	0.270 (0.27)	0.159 (0.60)
2.	EDUFR	-0.091 (0.03)**	-0.023 (0.67)	-0.126 (0.04)**
3.	EXPFR	0.175 (0.00)*	0.190 (0.00)*	0.160 (0.00)*
4.	LNDON	0.048 (0.06)***	0.015 (0.70)	0.304 (0.00)*
5.	PMKTS	-0.035 (0.05)***	-0.021 (0.45)	-0.036 (0.11)
6.	NTRTN	-0.022 (0.00)*	-0.017 (0.02)**	-0.042 (0.00)*
7.	SEXFR	0.122 (0.02)**	0.174 (0.07)***	0.123 (0.03)**
8.	MRTLS	0.026 (0.63)	-0.071 (0.35)	0.014 (0.78)
9.	ATTDF	0.302 (0.00)*	0.306 (0.00)*	0.213 (0.00)*
10.	FRMSZ	0.016 (0.64)	-	-
	R^2	0.797	0.830	0.822
	F-Value	148.00*	93.55*	103.18*

Note: * - significant at one percent level; ** - significant at five percent level; *** - significant at 10 percent level; and bracket shows the p-value.

The analysis shows that in the case of total farmers, all the nine explanatory variables jointly cause 79 percent of the variations in decision on choice of production method. Variables farmers' work experience, land ownership, farmers' sex, and farmers' attitude towards agri-chemicals have a positive and significant effect on dependent variable i.e., farmers' choice of organic production method. On the other hand, education, percentage of marketable surplus out of the total output produced and net returns are negatively and significantly related to the dependent variable. Farmers' attitude towards agri-chemicals is the most influential factor in choice of organic method of rice cultivation, indicating that organic farmers are more conscious of the ill effects of using chemicals on soil fertility and human health. The overall regression model emerges significant at one percent level.

In the case of small farmers, the study reveals that 83 percent of the variations in decision on choice of production method are caused jointly by the eight independent variables. Of all the eight variables, work experience, sex and farmers' attitude towards agri-chemicals have positive and significant impact on dependent variable however net return is negatively and significantly related to the dependent variable. The regression model for small farmers is found to be significant at one percent level.

As far as the medium farmers are concerned, all the eight variables together explain around 82 percent of the variation in the decision on choice of production method. Of all the independent variables, work experience, land ownership, farmers' sex, and farmers' attitude towards agri-chemicals have a positive and significant impact on the farmers' choice of production method. Whereas, education and net return are negatively and significantly related to the dependent variable. The regression model for the medium farmers emerges statistically significant at one percent level.

Thus, the study shows that farmers with better education, more net return, and higher percentage of marketable surplus out of the total output produced are more into inorganic farming. The cause may be due to the better returns earned from the inorganic rice cultivation, concluding that financial aspect thus plays a major role in the farmers' decision of production method. However, the variable sex of the farmers shows a positive impact on the dependant variable, indicating that female cultivators are more into organic farming. The reason for such behaviour could be that the output produced is mostly for the domestic consumption. Therefore being a female cultivator they are more concerned with the health of the family members. Land ownership also shows a positive and significant impact on the dependent variable, indicating that farmers owning more acres of land are more into organic farming. Finally, the variables like farmer's experience and farmer's attitude towards agri-chemicals also shows a positive and significant impact on the dependent variable, due to greater awareness on organic rice cultivation and experience.

6.3 Farmers' Attitude towards Environmental Issues

Table 6.3.1 reveals the farmers' attitude towards environmental problems. The first four items which states the positive attitudes of farmers towards protecting environment shows that majority of the organic farmers have agreed on the statements. In the case of the last two items which states a negative attitude towards protecting environment, it is observed that majority of the organic farmers disagree with the statements. Whereas, in the case of inorganic farmers, the table shows an opposite reaction by the farmers towards the environmental protection statements.

Thus, it can be concluded that organic farmers are more concerned towards protecting the environment, which may be one of the major causes of their cultivating rice using organic production method.

TABLE – 6.3.1
ORGANIC AND INORGANIC RICE FARMERS' ATTITUDE TOWARDS ENVIRONMENTAL ISSUES

Sl. No.	Particulars	M.S.D	S.D	D	N	A	S.A	M.S.A	T
A.	**Organic Rice Farmers**								
1.	Farmers attitude towards commercial fertilizers and pesticides reducing natural productivity of land	-	-	-	-	27	48	25	100
2.	Farmers' attitude towards maintaining proper balance in nature requires more complex form of operational organization	-	-	-	-	75	25	-	100
3.	Farmers' attitude towards chemical substance used in agricultural works are against nature	-	-	-	-	27	-	73	100
4.	Farmers' attitude towards farmers being the best protectors of natural environment	25	-	-	-	-	-	75	100
5.	Farmers' attitude towards commercial fertilizers and pesticides promoting high quality production	25	-	75	-	-	-	-	100
6.	Farmers' attitude towards environmental problems resulting from agriculture are exaggerated by media	100	-	-	-	-	-	-	100
B.	**Inorganic Rice Farmers**								
1.	Farmers attitude towards commercial fertilizers and pesticides reducing natural productivity of land	60 (24)	101 (40.40)	58 (23.20)	7 (2.80)	16 (6.40)	-	-	250 (100)
2.	Farmers' attitude towards maintaining proper balance in nature requires more complex form of operational organization	31 (12.40)	60 (24)	159 (63.60)	-	-	-	-	250 (100)
3.	Farmers' attitude towards chemical substance used in agricultural works are against nature	60 (24)	-	109 (43.60)	65 (26)	16 (6.40)	-	-	250 (100)
4.	Farmers' attitude towards farmers being the best protectors of natural environment	148 (59.20)	50 (20)	-	-	-	-	52 (20.80)	250 (100)
5.	Farmers' attitude towards commercial fertilizers and pesticides promoting high quality production	73 (29.20)	59 (23.60)	58 (23.20)	-	8 (3.20)	-	52 (20.80)	250 (100)
6.	Farmers' attitude towards environmental problems resulting from agriculture are exaggerated by media	124 (49.60)	66 (26.40)	-	-	-	60 (24)	-	250 (100)

Note: Brackets show row-wise percentage; M.S.D = Mostly Strongly Disagree; S.D = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; S.A = Strongly Agree; M.S.A = Most Strongly Agree; and T = Total.

CAHPTER - VII

MAJOR FINDINGS AND POLICY IMPLICATIONS

Agriculture is the most important economic activity of the people of Nagaland. The economy's remarkable feature is that there are no landless peasants in the State. Paddy is the staple food crop of the state and is almost grown in the entire cultivable area, from plain lands (valley land) to the hill slopes. The productivity of rice in the state is low as compared to world average productivity. This study makes a comparison of organic and inorganic rice cultivation by farm size in Dimapur district, Nagaland, to understand the economics of cultivating them across varieties and farm size, based on the input use, cost and return structure, farm size and efficiency relationship, yield determinants, yield gap and constraints and income inequality. Besides, it examines whether organic farming benefits the rural farmers as compared to the inorganic farmers by farm size. Thus the following are the main objectives of the study:-

1. to study the cost and returns structure of organic and inorganic rice cultivation by varieties across farm size in the study area;
2. to investigate the determinants of yield of the two rice varieties by farm size;
3. to identify the yield gap and its constraints with regard to the two rice varieties across farm size;
4. to analyse the farm size-productivity relationship of the two rice varieties; and
5. to examine inequalities in net income distribution of the farmers cultivating the two rice varieties.

Out of the 205 villages in Dimapur district, Suhoi and Kuhuboto villages were chosen for the study as these two villages have both the groups of farmers, i.e., one still practising the traditional organic farming and the other group practising the modern inorganic farming using hybrid seeds and improved techniques mostly for commercial purpose. Of the sixteen varieties of rice cropped in Nagaland, Ranjit (inorganic) and Naga Local/Special rice (organic) are the two widely and popularly cropped rice varieties by the farmers in the study area. Therefore the two varieties were chosen for the comparative study. The primary data were collected using pre-tested schedule from a total sample of 350 farmers cultivating rice during November-December 2013. Census method was adopted to collect data from all the 100 organic farmers cultivating Nagaland Special rice in Suhoi and Kuhuboto villages, Dimapur, Nagaland. In addition, a random sample of 250 inorganic farmers cultivating Ranjit rice variety was also selected from the two villages, as majority of the inorganic farmers cultivated Ranjit rice variety. To examine the farm-size effects, the data collected have been divided into two groups of small farmers (with land ownership of less than 4.95 acres) and the medium farmers (with land ownership 4.95 to 12.36 acres).

Secondary data were also used to describe the profile of the study area. The data for the same were collected from Agriculture Report 2012-13, Director Office, Department of Agriculture, Dimapur District; Office Record 2011-12, District office, Dimapur, Nagaland; Research Station Record Agriculture Department, Nagaland University, Medziphema, Nagaland; Statistical Handbook of Nagaland 2011, Directorate of Economics and Statistics Publishers, Nagaland; Village Record, Village Council office, Kuhuboto Area, Dimapur District for 2011 to 2014.

The objectives of the study were analysed using the statistical techniques like simple averages, ratios, percentages, correlation matrix, log linear production function, simple regressions, F-test, Chow test, Garrett Ranking Technique, Lorenz curve, Robin Hood Index and Gini index.

The major findings and their policy implications derived on the basis of the empirical analyses done are presented in this chapter.

7.1 Major Findings

The major findings of the study are summarized as follows:

1. **Farmer categories:** It was observed that out of 350 farmers, 162 (46.29%) were small farmers and 188 (53.72%) were medium farmers. Under the small farmers group, the number of organic farmers were 50 (30.87%) and inorganic farmers 112 (69.14%). Under medium farmer group, there were 188 total farmers (53.72%), of whom 50 (26.6%) were organic farmers and 138 (73.41%) were inorganic farmers.

The study revealed that out of the total 100 organic land owning farmers, 75 percent were males and 25 percent females. However, in the case of inorganic farmers, there were no female cultivators.

2. **Age and education:** Majority of the total farmers (43.43%) were in the age group of 40-50 years, followed by the age group of 30-40 years. The study also showed that the number of illiterates were three. The number of respondents with high school education were 69.43 percent, higher secondary 17.14 percent and 12.57 percent with college education.

Variety-wise result showed that under organic farmers, majority (48%) were in the age group of 40-50 years. About 77 percent of the organic farmers had high school education, followed by higher secondary education, college educated and only three percent illiterates. Under inorganic rice farmers, majority (55.2%) were in the age group of 30-40 years. Most of the inorganic farmers (66.4%) also had high school education, followed by higher secondary and college education. There were no illiterate respondents among the inorganic farmers.

3. **Input-output structure:** An overview of the input-output structure of the two rice varieties revealed that among all the inputs, the highest and significant difference was found for fertilizer (chemical for inorganic and organic manure for organic rice varieties). Next, output showed a significant difference between the two varieties. The analysis showed an evidence of a definite superiority of inorganic rice variety over the organic rice in terms of the average yield acquired per acre. Seeds per acre required for inorganic and organic rice cultivation was almost same. The average requirement of human labour for inorganic cultivation was less than required for organic rice cultivation, with t-test showing a significant difference. Bullock labour used per acre was almost the same for both the varieties. Use of pesticides was observed to be less by inorganic farmers. The irrigation cost was also observed to be higher for organic farmers than for the inorganic farmers.

Across farm size under both organic and inorganic rice farming, the level of most of the inputs application was higher for small farmers for both organic and inorganic rice cultivation. The cause for more intensive use of inputs by small farmers is because they are cultivating mainly for domestic consumption purposes, unlike the medium farmers who also cultivated for commercial purpose. However, the output yield was found to be higher for the medium farmers under both rice varieties.

The average quantity of seeds used per acre by small and medium farmers for organic rice cultivation was almost same. The bullock pair and human labour hired were also found to be similar. Small farmers applied more of organic manure than the medium farmers. Both small and medium farmers used indigenous pesticides to protect plant, which was more for small farmers than the medium farmers. The average irrigation cost was observed to be higher for the medium farmers than the small farmers. Output yield was also higher for medium farmers than for the small organic rice farmers.

As for inorganic rice farming, it was observed that application of inputs like seeds, pesticides, irrigation cost and human labour per acre was more for the small farmers compared to the medium farmers. However, inputs like chemical fertilizer was observed to be used more by the medium farmers than small farmers. The output yielded per acre was also higher for medium farmers than for the small farmers.

4. **Labour requirement:** The cost-return structure clearly showed that the cultivators of inorganic rice employed relatively more number of labourers and incurred a higher labour cost than the organic rice farmers. Of all the farm activities, the highest number of labourers was employed for harvesting by both the rice cultivators. It was also observed that in the case of organic rice cultivation, 46 percent of the total labour employed was family labour, whereas for inorganic rice cultivation it was only 29 percent, and the rest were hired labour. The composition of male and female labour employment showed that for both the rice varieties farming, only female labourers were employed for weeding, whereas for both plant protection activity and irrigation only male labourers were employed by both organic and inorganic farmers. Whereas for all other activities, both males and females were employed.

The farm size-wise cost and returns structure revealed that the expenses on total labourers employed by the small farmers for various farm activities were higher. For both the groups of organic farms, the composition of male and female labourers was almost similar for activities like land preparation, sowing and transplanting, application of fertilizers and manure. Under inorganic farming, the total cost incurred on employing labour was observed to be higher for medium farmers than for the small farmers. The ratio of male and female labourers employed under inorganic farmers was also almost similar for all the farm activities across both the farm size groups, except in weeding, irrigation, plant protection activities and harvesting activities.

5. **Cost and returns structure:** The cost structure showed that for both organic and inorganic rice cultivation, the total variable cost was observed to be higher for inorganic rice farmers as compared to the organic farmers. In particular, human labour cost, fertilizer cost and interest on fixed capital were observed to be more for inorganic farmers. However, bullock labour cost, seeds cost, irrigation cost, interest on working capital, and imputed rent on land were found to be more for the organic farmers. For both the rice varieties, expenditure on human labour accounted for a major share of the total cost, followed by rent.

   The returns structure revealed that inorganic rice variety yielded relatively higher quantity of rice and revenue per acre. The total variable cost incurred and the net income earned per acre by the inorganic rice variety were also comparatively higher than for the organic rice variety. Thus, it is concluded that the inorganic rice variety had performed better than the organic rice variety in terms of both total yield and profits earned per acre.

   Farm-wise cost structure for organic rice cultivation showed that the total variable cost incurred by the small farmers was more than the amount spent by the medium farmers. Expenditure on inputs for organic rice cultivation showed that for small farmers the variable cost formed more than two-third of the total cost. However for the medium farmers, the variable cost was nearly three-fourth of the total cost. For both the farm size, human labour constituted the major cost component. Rent was observed to be the next important item of expenditure for the both the farm size. Expenditure on bullock labour, organic manure, pesticides, irrigation cost, interest on fixed capital and rent differed significantly between the two farm size. The analysis indicated that although small farmers incurred a higher cost of cultivation, the medium farmers obtained higher net returns.

The farm-wise input cost of the inorganic farmers exhibited almost similar pattern under both the farm size groups. Variable cost formed about three-fourth of the total cost for both the farm size. Expenditure on human labour constituted the major cost, followed by rent. Like for the organic rice cultivation, per acre monetary returns and the net returns for inorganic farmers differed significantly between the small and medium farmers. Among the input cost, human labour cost, bullock labour cost, pesticides, irrigation cost, interest on fixed capital and rent differed significantly between the two farm size. The study indicated that unlike the organic farmers, small farmers had incurred a higher cost of cultivation, and obtained higher net returns in the case of inorganic farmers.

6. **Farm size-efficiency relationship:** The relationship between farm size and yield was observed to be positive and significant for organic farmers, implying that an increase in acres of land being used for rice cultivated increases the output produced. The relationship between farm size and productivity for inorganic farmers also showed a positive but insignificant relationship. However, a negative and significant relationship was found between farm size and labour used per acre for both organic and inorganic rice cultivation, indicating diminishing marginal returns. The relationship between farm size and average variable cost and average total cost also showed a negative significant result for both the organic and inorganic rice farmers, implying economies of scale.
7. **Purchase and sales market channels:** The study revealed that the producers of organic rice variety purchased the raw materials for their production activity from two main sources, i.e., local market and government outlet (50% each). Majority of the small organic farmers purchased raw materials from the government outlet, whereas most of the medium farmers used local market. In the case of inorganic farmers, majority of them used local market, followed by government outlet and the private agents. The same trend was observed for both the small and medium inorganic farmers.

Majority of both the organic and inorganic farmers sold their output to the private agents. The main cause behind this behaviour could be due to the absence of proper regulated market. Few of the organic farmers were observed to be selling their output to the consumer directly.

8. **Debt details:** The debt details for both the organic and inorganic rice farmers showed that most of the organic farmers took debt compared to inorganic farmers. Of the total debt holders, majority borrowed from friends, for a period of one year. The mode of repayment for majority was whenever income received.

9. **Accessibility to extension services:** Out of the total 350 organic and inorganic rice farmers, majority of them had no access to extension services. In the case of organic farmers, 50 percent used the extension services, of whom majority were medium farmers. However, among the inorganic rice farmers, only 24 percent used the extension services. This also means that most of the famers had no access to the extension services. Its accessibility to the small farmers and medium inorganic farmers was also low.

10. **Correlation analysis:** The correlation matrix showed that under organic rice farming, inputs like human labour and capital flow were a significantly correlated with yield at one and five percent level. In the case of both the small and medium organic farmers, inputs like capital flow and net return were significantly correlated with yield at one percent level. It was also observed that human labour had a significant positive correlation with the dependent variable yield. Very few variables were slightly more correlated with yield in the case of medium farmers. Whereas, capital flows and net returns were more correlated in all cases.

    Under inorganic rice farming, the correlation matrix showed that all the six inputs, except capital flows had a significant correlation with the yield. For inorganic small farmers, human labour, fertilizer and capital flow were significantly correlated with yield at one percent level. However for inorganic medium farmers, only human labour showed a positive significant correlation with yield. The matrix also showed that of all the six inputs for the combined inorganic farmers, fertilizer and net return were positively correlated to yield. In this case, the degree of correlation between capital flows and net returns was slightly higher for all farmer categories.

11. **Yield determinants:** The yield function result for total organic farmers, showed that all the six explanatory variables jointly caused 27 percent of the variations in yield. The variables human labour, fertilizer, pesticides and net return had positive impact on yield. However, only human labour had a positive and significant effect on yield. Whereas, capital flow, irrigation cost and farm size were negatively and significantly related to the dependent variable. In sum, human labour is observed to the most influential factor, indicating that employing more human labour contributes to increased organic rice yield. The overall regression model emerged significant at one percent level.

Regression result for the small organic farmers revealed that 25 percent of the variations in yield was caused jointly by the six independent variables. However, of all the six variables, only capital flow had negative and significant effect on yield. Although fertilizer, pesticides and irrigation had a positive impact on rice yield, their influences were statistically insignificant. The regression model for organic small farmers emerged significant at five percent level.

As far as the medium farmers are concerned, all the six variables together explain around 67 percent of the variation in the yield. Human labour, pesticides and net returns had a significant effect on yield. Pesticide had a negative significant impact on the dependent variable. Human labour and net returns contributed positively to yield increase. The regression model for the medium farmers was statistically significant at one percent level.

The yield determination analysis for inorganic farmers revealed that all the input variables together caused about 23 percent of variations in the yield of inorganic rice under the first model. Except for capital flows, rest of the variables showed a significant impact on the dependent variable. Fertilizer showed the highest positive and significant impact on yield. However, inputs like human labour and pesticides showed a negative significant impact on yield. The regression result of the second model (which included farm size as one of the independent variables) revealed that all the seven variables together cause about 29 percent of variations in the yield. Here, inputs like human labour, fertilizer, irrigation, net returns and farm size had significant impact on yield. Of them, fertilizer again was the most influential factor.

Human labour had a negative and significant impact on the yield. Both the regression models were statistically significant at one percent level.

The yield function result for the small inorganic farmers showed that all the inputs together caused about 45 percent of the variations in yield. Inputs like fertilizer, capital flow and net returns had a positive significant impact on yield. But, human labour showed a negative significant impact. Of all the three significant inputs, fertilizer proved to be the most influential factor, followed by capital flows and net returns. The regression model for inorganic small farmers was statistically significant at one percent level.

The yield function analysis for the inorganic medium farmers revealed that all the six variables together caused only eight percent of the variations on yield. Only human labour had a positive significant impact on yield, whereas capital flows had a negative and significant impact on yield. This model was found to be statistically significant at 10 percent level.

The chow test results showed that a structural difference existed between the yields of organic and inorganic rice varieties, and between small and medium farmers under both the varieties.

12. **Experimental station input-output structure and returns:** The experimental station's input-output structure and returns of both the rice varieties shows that the average requirement of human labour in the experimental station is more for organic cultivation. Chemical fertilizers applied at the experimental station for inorganic cultivation was 30 kgs. per acre, and the organic manure applied was 141 kgs. per acre for organic cultivation. The pesticides used per acre at the experimental station was similar for both organic and inorganic farming, and so was the average quantity of seeds used per acre. The irrigation cost per acre was also observed to be equal for both types of farming. However, it was observed that the total cost incurred is higher for inorganic rice cultivation as compared to the organic rice cultivation. The net income received was also observed to be higher for inorganic rice cultivation. This indicates that at the experimental station also inorganic farming is more profitable as compared to the organic farming.

13. **Yield gap and constraints:** Yield gap I and II analyses shows the existence of difference between their respective yields under both the rice varieties. The study shows that yield gap-I (i.e., the difference between the experimental station yield to the potential farm yield) was more for organic rice variety. However, in the case of yield gap-II, which is the gap between the potential farm yield and the actual farm yield, inorganic rice variety was observed to have higher gap as compared to the organic rice variety. When looked from the farm size point of view, yield gap-I and II were found to be higher for small farmers for the inorganic rice varieties. Whereas, only yield gap-I was higher for organic small rice farmers.

    The Garrett ranking results of the bio-physical reasons for yield gap revealed that water control was given the first rank by both organic and inorganic farmers. Second rank was given by the organic farmers to insect, followed by weeds, variety and then soil fertility. The Garrett ranking results of the socio-economic reasons of yield gap by both organic and inorganic farmers showed that both the groups of farmers ranked cultural practices as the first and most important constraint of yield gap. In the case of organic farmers, the second rank was given to risk aversion, which was ranked seventh by inorganic farmers. Credit, input availability, institutions, economic behaviour, knowledge and traditions were ranked third, fourth, fifth, sixth, seventh and eighth respectively by organic farmers, whereas they were ranked second, third, eight, fourth, fifth and sixth by the inorganic farmers respectively.

    The Garrett ranking of the other problems faced by both the groups of farmers showed that low price, low profit, lack of transport facilities, lack of extension services, lack of irrigation water and marketing problem were the major constraints for low productivity of the two rice varieties cultivation.

14. **Income inequality across rice varieties and farm sizes:** The study showed that income inequality existed between organic and inorganic rice cultivators, as well as between both small and medium farmers groups under both rice varieties. The Gini Index and Robin Hood Index results showed that inequality was relatively greater among the organic farmers as compared to inorganic farmers. From the farm size perspective, under both rice varieties income inequality was observed to be higher

among the small farmers as compared to the medium farmers. Finally, the F - test results indicated that significant difference existed between net returns of both the rice variety cultivators, as well as between both the farm size farmer groups of the two rice varieties.

15. **Determinants of decision on choice of rice cultivation method:** The result of choice of production method regression analysis showed that farmers with better education, more net return, and higher percentage of marketable surplus out of the total output produced were more into inorganic farming. However, the variable sex of the farmers showed a positive impact on the dependant variable indicating that female cultivators were more into organic farming. Land ownership also showed a positive significant impact on the dependent variable indicating that farmers owning lesser acres of land were more into inorganic farming. Finally, the variables like farmer's experience and farmer's attitude towards agri-chemicals showed a positive significant impact on the dependent variable. Finally the overall regression model was statistically significant at one percent level.
16. **Farmers' attitude towards environmental problems:** The table on farmers' attitude towards environmental problems revealed that organic farmers were more concerned about protecting the environment, which may have been the major cause of cultivating rice by using organic production method by them.

7.2 Policy Implications

Some of the important policy implications derived from the study are as follows:

1. Paddy being the staple food of the state, one need to draw the attention towards cultivating paddy through organic farming and help the organic farmers to earn more in order to improve their standard of living.
2. Appropriate steps should be taken to motivate more educated youths to take up organic farming.
3. In order to make paddy organic cultivation economically viable, labour requirements needs to be reduced to decrease labour cost through selective mechanism. Thus government needs to support the farmers to meet the labour

requirements through formulation of a package for adopting advanced mechanism.

4. One should concentrate in increasing the total cropped area through increase in cropping intensity and by bringing under cultivation the fallow land which covers around 9.36 percent of the land in the state.
5. With the rising input cost, the government needs to take a better look at the pricing policy for food grains.
6. Increasing the paddy cultivation requires large investments in rural infrastructures like road, electricity, irrigation, storage faculties, wholesale and retail markets. Hence, policies need to be identified for a state like Nagaland, where most of the farmers belong to marginal, small and medium farmers, for investments in infrastructure and technologies.
7. Proper marketing channels and marketing policies are necessary to increase the income of the farmers. Regulated market could be established in each sub-division of the district, so that the farmers can earn higher returns from their yields.
8. Government should also take proper steps to spread awareness about the ill-effects of pesticides and the importance of adopting alternative method of pest control through mass media programmes.
9. Extension services should be reached to a wider section of the farmers, so that they can increase their land productivity. This would also contribute to narrowing down of yield gap I and II.
10. Information and communication technology (ICT) should be popularised among the farmers, so that they can benefit from regular information dissemination on price of raw materials and output; availability of raw materials; importance of organic cultivation; formal credit facilities; ways and means of controlling pests, weeds and soil problems; plant diseases and means of controlling them; government policies for farmers; latest technologies and others.

Thus, it can be concluded that every inch of paddy land is precious from the economic point of view. So steps needs to be taken to protect the fertility of the soil and encourage the paddy organic cultivators by making paddy cultivation economically viable through adoption of advanced technologies, promoting agricultural knowledge and up-to-date market intelligence.

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APPENDIX – A: SCHEDULE

AN ECONOMIC ANALYSIS OF ORGANIC AND INORGANIC RICE FARMING IN DIMAPUR DISTRICT, NAGALAND – A CASE STUDY

Schedule – For Farmers

1.Family Structure:

Name: Region: Rural/Urban

Sl. No.	Nature of relationship to respondent	age	sex	Education (actual & years)	Marital status	Religion /caste	Health	Occupation Main/ subsidiary	Wage /day	Work Hrs./ day	No. of days worked per month	No. of months of work per year	Monthly income	Other income (pension, rent, etc)	Work experience (yrs)
1	Respondent											M- S-			M- S-
2															
3															
4															
5															

Religion & caste codes: Hindu- H; Muslim- M; Christian-C; Sikh-S; Buddhism-B; Jainism-J/ ST; SC; FC; BC; OBC

Occupation codes: Agricultural labourer-1; Business-2; Service (govt./private)- 3; house wife-4; credit activity-5.

Health status: normal-1; good-2; bad-3; very bad-4. Occupation: M= Main occupation; S= Subsidiary occupation.

Marital status: Single/married/divorced/separated/living-in If married, is your spouse with you?: Yes/No

2. Age at marriage: Wife: ------ Husband: ------- No. of married years: ------------

3. Standard of living indicators:

i. House ownership: Owned / Rent; ii. Type of house: Hut /Tiled / Concrete iii. Source of lighting: Electricity / Kerosene / Others,specify ___________;
iv. Source of drinking water: Tap (Private/Public) / Hand pump (Private/Public)/ Well (Private/Public); v. No of rooms: _________;
vi. Separate room for cooking: Yes / No; vii. Fuel for cooking: LPG / Kerosene / Biogas / Firewood /Combinations of ____________________
viii. Toilet facility: Toilet (separate/common) / Septic tank / open field; ix. Ownership of livestock: Yes / No; If yes: Milch cow ____/ Bullock ____/ Sheep ____/ Poultry _____/ Piggery ____/ Others ____.

x. Ownership of goods:

Fan(1) / Bicycle(2)/ Radio(3)/ Tape recorder(4)/ T.V.(B/W)(5) / T.V(color) (6) / Refrigerator(7) /Telephone(8) / Mixer(9)/ Grinder(10) / Washing machine(11) / Mobile phone(12) / Computer(13) /Two wheeler(14) / Car(15) / Tube well(16)/ Tractors (17) / Tillers(18) / Chairs(19) / Tables(20) / Almyrahs (21) / Stereo sets(22) / Vcd player(23) / Gas Stoves(24) / Clocks(25) / Electric irons(26) / Sewing Machine(27) / Gold Ornaments(28) / Silver(29) / Any other, specify______

xi. Ownership of Jewels: Bought: Weight _____ Sold: Weight _____

If sold, reason: ________________ Value: Rs. _____ Value: Rs. _____

xii. Ownership of land: Yes/ No

If yes: ______acre Value of land: Rs.______ of land: Rs.______

xiii. In whose name is the land ownership: Self/ Husband/ Both /Father-in-law/ Mother-in-law/ Others specify ______

xiv. Do you cultivate your land: Yes/ No

If yes, what crops do you cultivate: Season-I _______ Season-II ________ Multiple cropping _______

Season-wise Crop productivity: _ _ _ _ __ kg/acre Income per annum: Rs_ _ _ _

If no, why? (Rank): Sold off land ____ acres/seasonal employment/ lack of irrigation facilities/ low yield per acre/ insufficient income/ low profit/ lack of credit facility /dependency on monsoon/ others, specify _ _ _ _ _ _ _ _

4. Of the total produce, quantity used for domestic use _________ kgs.; surplus quantity sold in market ________ kgs.

5. Household expenditure per month (Rs.):

Sl. No	Particulars	Family	Son	Daughter	Husband	Wife
1	Food					
2	Fuel					
3	Clothing					
4	Education					
5	Health					
6	Entertainment					
7	Personal					
8	Miscellaneous					
9	Saving					
10	Travel					
11	Rent					
12	Others					
	Total					

6. Time use:

Sl. No.	Particulars in Minutes/ Day	Husband	Wife	Daughter	Son
1.	Cooking				
2.	Washing cloths				
3.	Washing dishes				
4.	Child care				
5.	Self care(Combing hair/Bathing/Dressing)				
6.	Tutorials (child)				
7.	Leisure(Watching TV/Outing/Meeting Friends/Movies/Listening to Music etc)				
8.	Shopping				
9.	Visiting friends or relatives				
10.	Cleaning house				
11.	Caring elders				
12.	Caring children				
13.	Sleeping				
14.	Paid employment (job Hrs.)				
15.	Travel(Workplace/ Visits)				
16.	Rest during day				
17.	praying				

7. What media you use?: mobile/ telephone/ internet/ radio/TV/Newspaper/Others, Specify.__________________________

8. No. of hours used per day: --------------- ------------ Amount spent per month: Rs.______________

9. Purpose of use (Rank):

TYPE OF MEDIA USED (Rank):			
A. Purpose of media used		B. Reason for media used	
i) Common verbal communication ii) Chatting iii) Personal messages/ email iv) General agricultural program information v) Business prospectus vi) Input availability information vii) Input application proportion information viii) Pest attack information ix) Fertilizer application information x) Price information xi) Product information xii) Technology information xiii) Credit availability information xiv) Market information xv) Others specify		i) Cheap media ii) Widely accessible iii) Govt. installed facility iv) Easy to operate v) Informative vi) Keeping up with technology development v) Up-dating with latest information (viii) Others, specify	

10. Do you use internet? : Yes/ No

If yes: own connection/paid centres/ work office/ educational institution/ others specify _ _ _

If no, reason: Illiterate/ No internet centre in the area residing/ Distance/ Costly/ No time/ No skill in computer use/ language problem/ others specify __ _ _ __

11. Off-season occupation: (i) self employed/ family business/ off-season short-term crop farming/ labourer (specify, agriculture-industry-construction)/ coolie/ housewife/ leave land uncultivated /SHG/MGNREGA/migrate for labour work/Others, specify.
income Rs. _ _ _ _per year
No. of days employed per year: __ _ _ _ _ Days per annum: ____ _ _ _
12. Do you save?: Yes/ No
If yes, how much?: _____________per month
13. Place of saving: Bank / Friends/At home/ Post-office/ Employer/ Relatives/ Money-lender / Others, specify ____
14. How is the saving utilized?: Productive purpose/ Unproductive purpose
Productive purpose: Business/ Raw material purchase/ Fixing pump for cultivation/ Agricultural land development/ Purchase of cultivation land/Input purchase/ Purchase of tractor/ Others, specify ____
Unproductive purpose: Marriage/ Festival/ Religious ceremony/ Funeral/ Education of children/ Food expenditure/ House construction/ Renovation/ Others, specify_ _ _
15. Debt detail: Amount, Rs. _______________
16. Source of borrowing: Bank / Friends/At home/ Post-office/ Employer/ Relatives/ Money-lender/ Others, specify ____
17. How is the borrowing utilized?: Productive purpose/ Unproductive purpose
i. Productive purpose: Business/ Raw material purchase/ Fixing pump for cultivation/ Agricultural land development/ Purchase of cultivation land/Input purchase/ Purchase of tractor/ Others, specify ____
ii. Unproductive purpose: Marriage/ Festival/ Religious ceremony/ Funeral/ Education of children/ Food expenditure/ House construction/ Renovation/ Others specify_ _ _ _ _
18. Period of loan_ _ _ _ _ Rate of interest per annum_ _ _ _ _percent
Subsidy, if any (Rs.)_ _ _ _ _
19. Mode of repayment: weekly/ monthly/ annual/ whenever income received/ others, specify_ _ _ _ _ _ _
20. Amount of loan and interest repaid: Rs. _ _ _ _ _ Principal Rs. _ _ _ _ Loan outstanding Rs._ _ _ _
21. Do you have any training in producing the commodity? Yes/ No

If yes, when and where .... Period of training............... Stipend received, if any (Rs.)................

Training fees paid, if any (Rs.).......... No. of trainings undergone with eriods..............

If no, do you have any previous experience in production?: Yes/ No, If yes, period ?...........

22. Cost of production:

Rent /month (if leased)	Raw materials (Rs./Kg)	Working capital (Loan invested)	Labour (no. Of labour & wage per day)	Transport (monthly)	Electricity (monthly)	Others

23. Raw materials purchased: Local /City/ wholesaler/ Retailer/ Agent/ Govt. Outlet/ Others, specify ....

24. Are raw materials easily available?: Yes/ No

25. Mode of transportation: Bus/ Lorry/Bullock/Carts/ By-cycle/auto/ Others, specify.............

26.Sales details - sold to whom?: Consumer directly/Agents/Retailer/Wholesalers/ Food Corperation/ Govt. directly/Regulated Market/Own shop/ Others, specify.........

27. Rank problems in order of priority:

Sl No.	Problems	Ranks	Sl No	Problems	Ranks
1	Difficulty in getting raw materials		7	Loan not received in time	
2	Lack of transport facilities		8	High rate of interest	
3	Lack of extension services		9	Lack of irrigation water	
4	Marketing problem		10	Labour problems	
5	Low price		11	Distance of market	
6	Low profit		12	Insufficient yield	

28. Inputs Availability Rates:

Do you know what are the recommended doses of inputs? Yes/No

If yes, have you applied the recommended doses of inputs? Yes/No

If no, why? Constraints in:

i. Farm finance

ii. Lack of extension services

iii. Non-availability of vital inputs, like power, water, etc

iv. Labour problem

v. Others, specify

29. Do you receive the necessary Extension Services regularly? Yes/No

If no, what are the constraints?

i. Long distance of village from Centre

ii. Extension service officials irregular

iii. Others, specify____________________

30. Yield:

Have you obtained the maximum possible yield? Yes/No

If No:

i. What is the maximum possible yield in the village? ____________kg/acre

ii. What is the quantity produced by you? ____________kg/acre

iii. Difference: your quantity................% to maximum output in village.

iv. What are the reasons for the difference?

Rank the following reasons as per priority.

Reasons:

Sl. No.	Bio-Physical	Rank	Sl. No.	Socio- Economic	Rank
1.	Water control		8.	Credit	
2.	Soil fertility		9.	Input availability	
3.	Problems of the soil		10.	Economic behaviour	
4.	Insects		11.	Risk aversion	
5.	Weeds		12.	Knowledge	
6.	Variety		13.	Institutions	
7.	Cultural practices		14.	Traditions	

31. Is your crop affected by any plant disease? Yes/No

If yes: Mention the disease__________________________________

What is the pesticides used______________________________________

32. Organic Manure:

Sl. No.	No. Of Cart Load (C.L)	Cost per C.L	Wage Rate	Application Cost in Rs.	Total Cost in Rs.

33. Inorganic Fertilizers:

Sl. No.	Fertilizer Used	Qty. in kgs.	Compo-nents of N.P.K.	Price per kg.	Value in Rs.	Total Application Charges in Rs.	Total Cost

34. Farm Inventory:

Particular	Year of Purchase/ Construction	Value at the time of Purchase/ Construction	Life Expected	Present Value in Rs	Maintenance Cost Per Year
A. Building & Structure: a) Farm house (dwelling-cum-storage)					
b) Cattle shed					
c) Pump shed					
d) Tractor shed					
e) Storage					
f) Threshing floor					
B. Wells & Irrigation Structure: a) Open well					
b) Bore well					
c) Irrigation channel					
C. Livestock in Number: 1. 2.					

35. Dead Stock:

Sl No.	Particulars	Year of Purchase / Construction	Value at the time of Purchase / Construction (Rs.)	Life expected	Present value (Rs.)	Maintenance Cost (Rs.)
1	Tractor					
2	Pump Set: i) Oil Engine ii) Electric motor					
3	Sprayers: i) Hand operated ii) Power operated					
4	Levellers					
5	Bund Formers					
6	Country Plough					
7	Bullock Cart					

36. Permanent Hired Labour:

No. of Labours Hired	Man-days Worked	Wage Bill per Annum		
		Kind Qty.	Cash Value	Cash Total in Rs

37. Family Labour:

No of Family Labours	Man-days Worked	Opportunity Cost in Rs

38. Propotion of Family Labour to Total Labour:___

39. Preparatory Cultivation:

Sl. No.	Operation	No. Of Bullock Pair	Hire Charges per Pair	Expenditure on Bullock Pair	No. of		Wage Rate in Rs		Total Wages in Rs
					M.L	F.L	M.L	F.L	
1.	Ploughing								
2.	Levelling								
3.	Rectification of Bunds, etc.								

40. Seeds and Sowing:

Sl. No.	Variety	Source	Quantity in kg.	Price per kg.	Value in Rs.	Certified/ Non-certified	No. of		Wage Rate		Total Cost
							M.L	F.L	M.L	F.L	

41. Transplantation:

Sl. No.	No. of		Wage in				Value per Unit	Total Cost in Rs
	M.L	F.L	Cash (Rs)		Kind (Qty)			
			M.L	F.L	M.L	F.L		

42. Weeding:

Sl. No.	No. of Hand Weeding	No. of		Wage Rate		Total Cost in Rs.
		M.L	F.L	M.L	F.L	

43. Plant Protection Measures:

Sl. No.	Chem-ical used	Qty. used	Price per unit	Value in Rs.	Area spra-yed	Rent for Spr./ Dtr.	Fuel Cha-rges	Applic-ation charge per Tank	No. of Tanks	Appli-cation Cost	Total cost in Rs.

44. Total Irrigation cost: Rs.______________

45. Harvesting:

Sl. No.	No. of		Wages in				Value per Unit	Total Labour Cost in Rs.	Qty. of Rice Harvested in kg.
			Cash (Rs.)		Kind (Qty.)				
	M.L	F.L	M.L	F.L	M.L	F.L			

46. Threshing:

Sl. No.	No. of		Wages in				Value per Unit	Total Labour Cost in Rs.	Qty. of Rice Harvested
			Cash (Rs.)		Kind (Qty.)				
	M.L	F.L	M.L	F.L	M.L	F.L			

47. Problem-based knowledge:

i) If you were to observe a major case of environmental contamination, would you know to whom you could make a complaint? [yes/no]

ii) How would you grade your knowledge of "environmental problems"? [1–5]

[3 left:right » agree:disagree strongly]

iii) A society that gives higher priority to environmental protection than to economic development	3 2 1 0 1 2 3	A society that gives higher priority to economic development than to environmental protection

iv) How well informed are you about the following problem areas: [3 left:right » agree:disagree strongly]

Nitrate burden and groundwater?	3 2 1 0 1 2 3
Pesticide residues in food?	3 2 1 0 1 2 3
Productivity increases through use of hormones?	3 2 1 0 1 2 3
Environmental protection regulations and measures in agriculture?	3 2 1 0 1 2 3
Environmental protection regulations and measures in the household?	3 2 1 0 1 2 3

48. General attitude towards the environment: (this includes those emotions and cognitive attitudes that affect the various aspects of environmental problems of society as a whole.)

Indicate your agreement or otherwise with the statements below: [3 left:right » agree:disagree strongly]

I do not believe that the environment is as polluted as people say	3 2 1 0 1 2 3
Mankind has always solved its problems until now, and it will also master the problem of environmental contamination	3 2 1 0 1 2 3
Air quality is becoming worse because of the dust and poisonous substances	3 2 1 0 1 2 3
The result of human folly in respect of the environment will be massive changes in climate	3 2 1 0 1 2 3
Chemical substances found in food today have no negative effects because they are present in very low concentration	3 2 1 0 1 2 3
Nuclear power plants should be closed down	3 2 1 0 1 2 3
There will soon be a shortage of freshwater in our latitudes because of environmental contamination	3 2 1 0 1 2 3

49. Environmental attitude as a farmer: (they represent an emotional and cognitive attitudinal dimension related to the respondent's own sphere of activity, occupational and otherwise.)

Indicate your agreement or otherwise with the statements below: * [3 left:right » agree:disagree strongly]

Agricultural activities today lead to the destruction of natural biotopes and to a reduction in wildlife as well as wild plants	3 2 1 0 1 2 3
Commercial fertilisers and pesticides reduce the continuing natural productivity of the land and the product quality	3 2 1 0 1 2 3
The use of chemical substances in agriculture works against nature	3 2 1 0 1 2 3
Environmental problems resulting from agricultural activities are exaggerated by the media	3 2 1 0 1 2 3
The groundwater burden resulting from the washing out of fertiliser is worse than many people imagine	3 2 1 0 1 2 3
Farmers are the best protectors of the natural environment, even if mistakes are made from time to time	3 2 1 0 1 2 3
Commercial fertilisers and pesticides have no harmful effects; they promote high-quality production	3 2 1 0 1 2 3
The use of chemicals in agriculture makes sense as long as it brings greater returns than costs	3 2 1 0 1 2 3
Maintaining a proper balance in nature requires a more complex form of operational organization	3 2 1 0 1 2 3

* Certain questions served as "controls" to check for consistency in responses. Such "reversed" questions were not placed within the same subset of questions in the actual questionnaire.

* Note: 3 left:right » agree:disagree strongly

50. Feeling of stress: (The consciousness of being burdened by environmental problems, registered as the subjectively perceived stress).

i) **Do you feel personally affected by environmental problems in your area?** [yes/no]

If so, which?____

ii) **Let us assume that a nitrate burden bordering on the critical has been discovered in the drinking water that comes from your community´s own common well. How would you react?** [3 = agree strongly]

The situation would bother me a lot	3 2 1 0 1 2 3	The situation would not bother me at all

51. Preparedness to act: (This, as a component closely allied to "action" itself, represents the readiness of an individual to change something in his or her behaviour).

i) How would you react to such a nitrate burden in drinking water? [3 left:right » agree:disagree strongly

First think it over quietly and continue as always	3 2 1 0 1 2 3
Something must be changed immediately; things cannot continue as they have until now	3 2 1 0 1 2 3

ii) Would you take part in a campaign to clean up a polluted landscape [yes/no]

iii) If your future income were assured by means of agricultural policies, that is to say no net economic disadvantage would result, would you then of your own accord: [3left, yes indeed; 3 right, definitely not]

Take additional measures to conserve the landscape?	3 2 1 0 1 2 3
Use less chemical sprays?	3 2 1 0 1 2 3
Use fertilisers only in "environmentally appropriate" quantities?	3 2 1 0 1 2 3
Manage completely without chemical insecticides and mineral fertilisers, i.e. switch over to organic farming?	3 2 1 0 1 2 3

iv) Would you take part in a campaign to clean up a polluted landscape [yes/no]

v) If your future income were assured by means of agricultural policies, that is to say no net economic disadvantage would result, would you then of your own accord**:** [3 left, yes indeed; 3 right, definitely not]

Take additional measures to conserve the landscape?	3 2 1 0 1 2 3
Use less chemical sprays?	3 2 1 0 1 2 3
Use fertilisers only in "environmentally appropriate" quantities?	3 2 1 0 1 2 3
Manage completely without chemical insecticides and mineral fertilisers, i.e. switch over to organic farming?	3 2 1 0 1 2 3

52. Have you ever taken part in a meeting of an environmental protection organisation? [yes/no]

53. Are you or have you ever been a member of an environmental protection organisation? [yes/no]

If yes, name it. ________________________________

54. Do you farm according to the guidelines for organic farming? [yes/no]

If no, why? _______________________________________

55. Have you done anything during the last three years that was specifically oriented towards the conservation of **nature, the landscape or the environment?** [yes/no]

If yes, then what? [measures to be indicated yes/no from among the following]

• Changes in fertiliser or pesticide use

• Changes in the preparing and working the soil

• Changes in crop rotation

• Testing or analysis of: the soil; spraying equipment; etc.

• Requesting advice on environmental questions relating to your farming activities

• Proper disposal of containers for spray chemicals as well as other polluting substances or objects (old batteries, motor oil, etc.)

• Other (to be specified)

56. Do you avoid the purchase of certain products because they burden the environment? [yes/no]

57. Have you ever made a formal complaint concerning environmental pollution? [yes/no]

APPENDIX – B: GARRETT’S RANKING TABLE

Percent Score	Score	Percent	Score	Percent	
0.09	99	22.32	65	83.31	31
0.20	98	23.88	64	84.56	30
0.32	97	25.48	63	85.75	29
0.45	96	27.15	62	86.89	28
0.61	95	28.86	61	87.96	27
0.78	94	30.61	60	88.97	26
0.97	93	32.42	59	89.94	25
1.18	92	34.25	58	90.83	24
1.42	91	36.15	57	91.67	23
1.68	90	38.06	56	92.45	22
1.96	89	40.01	55	93.19	21
2.28	88	41.97	54	93.86	20
2.63	87	43.97	53	94.49	19
3.01	86	45.97	52	95.08	18
3.43	85	47.98	51	95.62	17
3.89	84	50.00	50	96.11	16
4.38	83	52.02	49	96.57	15
4.92	82	54.03	48	96.99	14
5.51	81	56.03	47	97.37	13
6.14	80	58.03	46	97.72	12
6.81	79	59.99	45	98.04	11
7.55	78	61.94	44	98.32	10
8.33	77	63.85	43	98.58	9
9.17	76	65.75	42	98.82	8
10.06	75	67.48	41	99.03	7
11.03	74	69.39	40	99.22	6
12.04	73	71.14	39	99.39	5
13.11	72	72.85	38	99.55	4
14.25	71	74.52	37	99.68	3
15.44	70	76.12	36	99.80	2
16.69	69	77.68	35	99.91	1
18.01	68	79.17	34	100.00	0
19.39	67	80.61	33		
20.93	66	81.99	32		

Source: Henry, E. Garrett and R.S. Woodworth, “Statistics in Psychology and Education”, Vakils, Feffer and Simons Private Ltd., Bombay, 1969, p.329.

APPENDIX – C: PHOTO GALLERY

WAREHOUSE (ALHE in LOCAL DIALECT)

BASKET USED FOR CARRYING FOODGRAINS (AMTO in LOCAL DIALECT)

TOOL USED DURING LAND PREPRATORY ACTIVITY