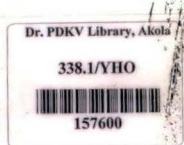


**ECONOMIC ANNALYSIS OF TRADITIONAL AND
SRI METHOD OF PADDY CULTIVATION**

THESIS

Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
in partial fulfilment of the requirements
for the Degree of

**MASTER OF SCIENCE
IN
AGRICULTURE
(AGRICULTURAL ECONOMICS)**



By

THORAT RUSHIKESH SHASHIKANT

**SECTION OF AGRICULTURAL ECONOMICS AND
STATISTICS
COLLEGE OF AGRICULTURE, NAGPUR**

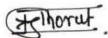
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2013

DECLARATION OF STUDENT

I hereby declare that, the experimental work and its interpretation of the Thesis entitled, "**ECONOMIC ANALYSIS OF TRADITIONAL AND SRI METHOD OF PADDY CULTIVATION**" or part thereof has neither been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.



Place: Nagpur

(THORAT RUSHIKESH SHASHIKANT)

Date: 21/05/2013

Enrolment No: JJ/2278



CERTIFICATE

This is to certify that thesis entitled "**ECONOMIC ANNALYSIS OF TRADITIONAL AND SRI METHOD OF PADDY CULTIVATION**" submitted in partial fulfilment of the requirement for the degree of "**Master of Science in Agriculture (Agricultural Economics)**" of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Thorat Rushikesh Shashikant** under my supervision and guidance.

The subject of the thesis has been approved by the Student's Advisory Committee.



(Dr. N.V. Shende)

Chairman,
Advisory Committee

Place : Nagpur

Date : 31/05/2013

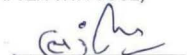

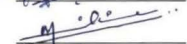

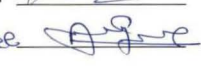
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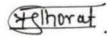
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(Thorat Rushikesh Shashikant)

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
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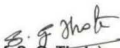
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(C)**Abbreviations**

%	Percentage
/	Per
@	At the rate of
OLS	Ordinary Least Square
<i>et al.</i>	Et alia (and associate)
etc.	Et cetera
Fig.	Figure
G.C.A.	Gross cropped area
G.I.	Gross Income
ha.	Hectare
i.e.	That is
PDS	Public Distribution System
MT	Metric Tonne
N. R.	Net Returns
No.	Number
FYM	Farm Yard Manure
p.a.	Per Annum
qt.	Quintal
Qty.	Quantity
PPC	Plant Protection Chemicals
Resp.	Respectively
Rs.	Rupees
Unpub.	Unpublished
Viz.	Namely

(D) **THESIS ABSTRACT**

- a) Title of the Thesis : **ECONOMIC ANALYSIS OF TRADITIONAL AND SRI METHOD OF PADDY CULTIVATION**
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ABSTRACT

Paddy (*Oryza sativa* L.) is a member of gramineae family. It is the world's second important food crop after wheat because of yield potential and high nutritive value. India ranks first in area and second in production. The present study "Economic analysis of traditional and SRI method of paddy cultivation" was undertaken to know the cost and returns, factor affecting and constraint faced by farmers in cultivation of paddy.

SRI-System of Rice Intensification is a system of production of rice. SRI is considered to be a disembodied technological change in paddy cultivation. SRI involves the use of certain management practices, which together provide better growing conditions for rice plants, particularly in the root zone, than those for plants grown under traditional practices. This system seems to be promising to overcome the shortage of water in irrigated rice. It offers increased productivity for resources like land, labour and water. In fact, it is a less water requirement method of rice cultivation, which is suitable to poor farmers who have relatively more labour than land and capital.

Data was pertaining to the Kharif season of the agriculture year 2012-13. Total 120 paddy growers were selected for the study. The standard cost concept was used for work out per hectare cost and returns, decomposition analysis. The constraint in cultivation was identified. The following conclusion was drawn from the present study:

The average age of selected farmers was 44 year in traditional and SRI methods. The average education was 8th standard in traditional and SRI method. In the type of family about 92 to 95 per cent farmers were belong in nuclear family in both methods. Whereas in joint family the 8.34 per cent farmers in traditional method and 5.00 per cent farmer in SRI method. In the traditional method average family income was Rs.37,350 and SRI method was Rs.38,467. The average

size of holding was 1.66 hectares in traditional method and 1.23 hectares in SRI method.

The major expenditure item of nursery cost was expenditure made on seeds in traditional paddy (Rs. 1194.79) and SRI paddy (Rs. 174.11). The per hectare cost of cultivation in the case of SRI method paddy farmers was higher than the traditional method paddy farmers. The Per quintal Cost of production of traditional method paddy growers was Rs. 1057.48. It was higher in SRI method paddy growers i.e. Rs. 914.55. The return per rupee spent was around Rs. 1.92 for SRI paddy method and Rs. 1.55 for traditional paddy method.

The productivity difference between yield of main produce in the SRI paddy and traditional paddy was estimated to be 14.39 per cent and yield of by produce was 17.43 per cent respectively. The sum of regression coefficient was found to 0.274 and 0.174 in case of traditional and SRI method of paddy cultivation. However, decreasing returns to scale were noticed in both traditional paddy and SRI paddy production.

The study has revealed that adoption of SRI technique would help increase in rice production without increasing the area under cultivation. Major reasons for practicing SRI method by sample farmers were higher yield levels and less seed rate. Major constraints in practicing SRI method were labour requirement is more, weed menace and required skilled labour.

Chapter I

INTRODUCTION

1.1 Background Information

Rice (*Oryza sativa* L) is the staple cereal crop not only of India but also of other tropical and subtropical countries of the world. Paddy is a member of gramineae family. The rice grain contains mostly starch although the protein content of rice is quantitatively less than wheat; it is superior to wheat and is easily assimilated by the body. It is grown in the country under diversified situation ranging from rainfed lowland where stagnates up to 300 cm to rainfed upland where there is no water stagnation. In between rainfed upland and rainfed lowland different varieties are cultivated depending upon the depth of water.

Paddy cultivation probably dates back to antiquity and had probably been the staple food and the first cultivated crop in Asia. Paddy that is rice has been cultivated since ancient times. From the study of Sanskrit and of the different languages in South Eastern Asia, many investigations have concluded that rice was known in India before present era. India and Burma should be regarded as the center of origin of cultivated rice where different species of rice were originated.

There are two most important cultivated species of paddy namely i) *Oryza sativa* and ii) *Oryza glaberrimum*. There are around 18 wild species of paddy grown in the continents of Asia, Africa and America. While *Oryza sativa* is grown in most parts of the Asian and American continents, *Oryza glaberrimum* is grown only in Africa. There are three sub species of paddy in the world i.e. *Indica* (long grain), *Japonica* (round grain) and *Javanica* (medium grain). *Indica* rice is grown in warm climate zone of Indo-China, India, Pakistan, Thailand, Brazil and Southern U.S.A., *Japonica* is mostly grown in cold climate zone of Northern China, Korea, Japan and California. The *Javanica* is

grown in Indonesia only. The *indica* variety is long-grained, for example Basmati rice, grown notably on the Indian sub-continent. *Japonica* rice is short-grained and high in amylopectin (thus becoming "sticky" when cooked), and is grown mainly in more temperate or colder regions such as Japan. *Javonica* rice is broad-grained and grown in tropical climates. Paddy is a self-pollinated crop. A complete seed of rice is called paddy and contains one rice kernel. Outer layer of rice shell is called husk. The next layer is called rice bran and the innermost part is called rice kernel.

Rice is one of the important food crops in the world and rank second in terms of area and production. It is the staple food for about 50 percent of the population in Asia, where 90 percent of the world's rice is grown and consumed. The world population is increasing at the alarming rate than food production. The big question raised in front of the whole world now is how to meet the demand for food. To meet the needs of the increasing population, the production should be increased. It would be an easy task to increase the production very quickly because there is very limited scope for increasing area under food grains. Asia's food security depends largely on the irrigated rice fields, which account for more than 75 percent of the total rice production (Virk *et al.*, 2004). Rice is a proliferate user of water, consuming half of all fresh water resources. In Asia, 17 million ha of irrigated rice area may experience "physical water security" and 22 million ha may have "economic water security" by 2025 (Tuong and Bouman, 2001). Water has become a scarce resource in the world as well as in India. Water needs of rice are two to four times more than that of the other crops of the same duration because of water loss by percolation, seepage, field preparation, etc. under submerged condition.

The chemical composition of rice grain varies considerably depending on the genetic factor of the rice varieties and on environmental conditions such as location, season, fertilizer application and post-harvest operations. Rice is an important food crop contributing

to more than half the daily requirement of calories. It contains 6 to 7 percent proteins and 2 to 5 percent fat only. Grain contains calcium and vitamin B. Rice is primarily a high energy calorie food. The major part of rice consists of carbohydrate in the form of starch, which is about 72-75 percent of the total grain composition. The protein of rice contains glutelin, which is also known as oryzenin. The nutritive value of rice protein (biological value = 80) is much higher than that of wheat (biological value = 60) and maize (biological value = 50) or other cereals. Rice contains most of the minerals mainly located in the pericarp and germ and about 4 percent phosphorus. Rice also contains some enzymes.

The by product of rice is used as for cattle and poultry feed. Paddy husk is used in manufacture of insulation materials, cement and cardboard and either for poultry keeping. Rice is also consumed in the form of noodles, puffed rice, fermented sweet rice and snack foods made by extrusion cooking. It is used in making beer, rice wine and vinegar. Rice bran mixed in adequate quantities with other ingredients is used as a feed for domestic animals. The oil extracted from the rice bran, which is rich in vitamin E, is used for cooking purpose.

The world paddy production was 465.81 million tonnes in 2011-12, covering on area of 158.92 million hectare with an average yield of 4.37 tonnes per hectare. Developing countries contribution about 90 per cent of the world total rice production. In India, area under rice was 44.10 million ha with production 105.31 million tonnes and productivity is 3.58 tonnes/ha during the year 2011-12. Which share in world area and production is 24 percent and 18 percent respectively. In China area under rice was 30.6 million ha with production 140.70 million tonnes and productivity is 6.69 tonnes/ha during the year 2011-12. In Indonesia, area under rice was 12.16 million ha with production 36.50 million tonnes and productivity is 4.73 tonnes/ha during the year 2011-12. In Bangladesh, area under rice was 11.72 million ha with production 33.70 million tonnes and productivity is 4.31 tonnes/ha

during the year 2011-12. In Thailand, area under rice was 11.00 million ha with production 20.46 million tonnes and productivity is 2.84 tonnes/ha during the year 2011-12. In Vietnam, area under rice was 7.74 million ha with production 27.15 million tonnes and productivity is 5.61 tonnes/ha during the year 2011-12. In world USA was the highest productivity in rice during 2011-12. (Anonymous^b, 2012).

The conventional paddy growing tracts are in worst crisis due to social, biological and technical setbacks. Well acclaimed rice bowls in several part of the nation is facing a decline in area, production and productivity. In India, there is a growing demand for rice due to ever escalating population. Rice is consumed both in urban and rural area and its consumption is growing due to high-income elasticity of demand. To meet the growing demand, a rapid income in paddy production is needed. But there is little scope to increase the area; hence increase in production and productivity with an improvement in efficiency of production to act as a technological breakthrough to meet the growing demand.

In Maharashtra, rice is the staple food and area under rice was 14.7 lakh ha, production is 31.7 lakh tonnes and productivity was 2.157 lakh/ha during the year 2011-12. In India, West Bengal was highest in area (56 lakh ha) and Punjab was highest in productivity (5.82 tonnes/ha). In Maharashtra the highest area and production of rice in Vidharba region 7.53 lakh ha (49.78%) and 15.72 lakh tonnes during the year 2011-12. In Vidharba region, Chandrapur district area under rice was 1.143 lakh ha, production 2.332 lakh tonnes and productivity 14 qt/ha. However Bhandara district area under rice was 1.185 lakh ha, production 2.588 lakh tonnes and productivity 14.26 qt/ha. (Anonymous^a, 2012.)

The System of Rice Intensification (SRI) is a method of paddy cultivation, though some consider and treat it as a technology. SRI is considered to be a disembodied technological break through in paddy

cultivation. SRI involves the application of certain management practices, which together provide better growing condition of rice plants, particulate in the root zone, than those for plants grown under traditional practice. This system seems to be promising to overcome shortage of water in irrigating rice. SRI was first introduced in Madagascar during the early 1980s by a French Missionary Priest, Father Henri de Laulanie, S.J. Since then SRI has been widely studied, researched and debated. SRI is a recent entry in to India. Formal experimentation of SRI in India was started in 2002-03 and Andhra Pradesh among the first state SRI has emerged as an important technology for rice production. SRI method totally deviates from the traditional way of cultivating irrigated paddy over centuries and hence it has differed any water saving capabilities. It in fact, challenges the received wisdom of paddy. SRI is environment-friendly. Reduced demand for water and frees up water for other users and soil that is not kept saturated has greater biodiversity. Un-flooded paddy fields do not produced methane, one of the major "green house gasses" that are contributing towards global warming. The method uniqueness includes using less seeds, less water, less chemicals, etc. Paddy nursery is raised using 2 to 3 kgs seed per acre of paddy as against the usual 30 kgs. Transplantation of the seedling is carried out fairly early, i.e., within 2 week after sowing as against 4-5 weeks. Transplanting is done in wide spaces of 20x20 or 25x25 centimeter with only one seedling per spot and henc the saving on seeds. The species transplanting allows for the spread of the plant with more number of tillers, i.e., between 50 and 100 as against 20 and 30 in the traditional case. SRI challenges assumptions and practices that have been in place for 100, even 1000 of years. Most rice farmer plant mature seedlings in clumps, fairly closely, with standing water maintained on the field for as a large part of the season as possible with the ideas of reducing the risk of crop failure.

Land is prepared in the normal way of paddling for the transplantation of SRI. Seedlings are transplanted as soon as possible

after being removed from the nursery within half an hour. Careful transplanting of seedling when they are very young reduces shock and increases the plant's ability to produce numerous tillers and roots during their vegetative growth stage. After the transplantation irrigation is provided for SRI intermittently whenever land is dry with no standing water on the field. Scientifically this appears to help healthy growth of plant with stronger root zone due to better availability of oxygen at root zone than those for plants growth under traditional practices. Though it looks so simple it took so many years for the agricultural scientists and farmers to observe this aspect. After transplanting the first 60 days are the most challenging, tedious and distressing to the farmers who are new to this method of cultivation. Distressing because the paddy field do not look like traditional paddy fields, the field are cover with half dry feeble stems leaving the farmer with depressing feeling of 'what have I done. To add to the psychological problems the fields need more number of weeding as against little or no weeding in the traditional case. Though weeding can be carried out with rotar weeder to reduce labour intensity, the practice is yet to established due to the requirement of experience and skills. It is recommended that SRI needs little fertilizers and only organic manure would suffice. In fact, SRI was initiated in the 1980s in the Madagascar mainly to address the fertilizer shortages. But, an often farmer, as in our case, tends to apply more fertilizer in the initial stages with the perception that their paddy plants are weak and fragile. However, the sense would change once the tillers start coming after 60 days or so SRI is expected to have 2-3 times more when compared to the traditional methods. More tillers per plant are expected to compensate for the spacious transplanting as well as less number of plants. Each tillers would bear padding, that too strong ones, and hence more yield.

The system of rice intensification (SRI) is the most acclaimed method of rice farming with claims of yield gains in the range 2-3 times along with cost reduction. In fact, organic farming is best suited for SRI cultivation the experience of SRI is often referred to as 'too good to be

true' (Uphoff, 1999, 2000 and Uphoff & Rnadriamdarisoa, 2002). SRI is the method of rice cultivation based on the synergy among several technics like seeding on dry bed, transplanting the seedlings younger than 15 days, wider spacing (20x20 or 25x25) with single plant, intermittent irrigation with no standing water, frequent weeding, etc. (Barrett *et al.*, 2003). SRI has emerged as an important technology for rice production. SRI is amalgamation of refined and intensive management practices of rice production with advantages of production enhancement and cost reduction. The specificities of SRI are conservation of land, water and bio-diversity and utilization of biological power of plant and solar energy. Yield sustainability of SRI has both macro and micro economic importance. In other words, sustained yield levels among the community will insure stable production and in turn food security, while economic sustainability would encourage the farmers to adopt the technology over time and space. On the other hand, the traditional method of paddy cultivation requires large quantities of inputs, particularly water, fertilizer and pesticides, contributing to with cost of cultivation. It leads to depletion of water levels, indiscriminate use of chemical fertilizers and pesticides damaging the ecosystem equilibrium and reducing the quality of produce, leaving the residues behind.

SRI method differs from the traditional method of rice cultivation as given below.

1. Nursery Management: Firstly, raised seed bed prepared by a well mixture of FYM and soil either on polythene covers, banana sheaths etc. or on soil itself. Secondly, seed rate five kg per hectare is sufficient as against 50 to 62.5 kg in traditional method. Thirdly 8 to 12 days aged seedlings transplantation with two small leaves and seed attached to the plant as against 25 days and above in traditional method of rice cultivation.

2. Transplanting to main field: Seedlings should be removed carefully from the nursery without disturbing the roots of the plant

along with seed and single seedling should be transplanted per spot in the main field. Water in the main field should be drained out before transplanting.

3. Wide spacing: Wider spacing of 25 x 25 cm in square pattern should be maintained for better aeration and for easy intercultural operations due to line plantation with the help of rotavator as against 50 to 60 hills per square meter in traditional method.

4. Weeding: Naturally weed growth is more in SRI fields because there is no stagnated water. Weeding should be done with rotary weeder/ conoweeder for at least four times with an interval of 10 days starting from tenth day after planting. It churns the soil and the weeds are incorporated in the soil, which in turn serves as organic manure. It helps in increased soil aeration and soli health.

5. Water management: The soil should be kept moist but not to break the soil also not saturated by providing alternating wetting and drying.

6. Manure and fertilizer: Application of more of organic manures i.e. 8 tonnes per ha should be used and apply fertilizer based on soil test results.

1.2 Importance of study:

Paddy is grown in Bhandara and Chandrapur district on large scale occupying the area. Paddy has, not only important place in internal market, but has its place in international market too. It has assumed a discernible significance with wider precepts and better potential. Hence, effort must be made for boosting the production of paddy in the country which has high potential for export. In view of growing demand for domestic consumption and export various agencies recognized the urgent need for increasing production in Bhandara and Chandrapur district. Paddy marketing is the performance of all business activities in the flow of paddy and milled

rice from the point of initial production until they are in the hands of the ultimate consumers.

1.3 Objectives:

- 1) To study the socio-economic characteristic of selected farmers.
- 2) To estimate the costs and returns of paddy cultivation under SRI and traditional method of cultivation.
- 3) To identify the important factors affecting production of paddy under SRI method and traditional of cultivation.
- 4) To decompose the contribution of resources to the production differences between traditional and SRI method.
- 5) To identify important constraints in adoption of SRI method.

1.4 Hypothesis:

- 1) SRI method of paddy cultivation is profitable than traditional method.
- 2) The techniques of SRI method contributes to the productivity differences.
- 3) There are constrains in the adoption of SRI method.

1.4 Scope and limitation:

This study would help the farmers for earning money and increasing farm income from the cultivation of paddy crop which gives continuous higher income by maintaining irrigation facilities and financial facilities. Rice yields have been increasing since the 1960s, but since the 1990s, growth in rice production has been slower than population growth. Indeed, it is anticipated that rice production will need to increase by 30% by 2025 in order to sustain those who need it for sustenance.

The cultivation of paddy crop engages farmers, his family and labour. It supply food stuff to his family and provide the better utilization of land, labour, and capital. In addition to this it reduces pressure on cereal as well as it gives a much higher return.

The study has undertaken according to tehsil, hence the researcher get idea about cost A, production, net return and marketing of paddy, at tehsil level as the study concerned with specific area (Bhandara and Chandrapur district). The application of the result will be useful only for the areas which has similar situation.

Chapter II

REVIEW OF LITERATURE

The review of literature is one of the important aspects in the research process which help the researchers to get acquainted with the subject matter under study and future channelize efforts in desirable directions.

This chapter deals with the presentation of relevant literature on same and related studies done by the past research workers.

For the present investigation collected literature is presented under the following sub heads.

- 2.1 Cost and returns of rice cultivation.
- 2.2 Factors contributing to yield difference.
- 2.3 SRI method in rice cultivation.
- 2.4 Constraints in different farming systems.

2.1 COST AND RETURNS OF RICE CULTIVATION

Gupta *et al.* (1985) examined the economics of paddy cultivation on different size groups in Haryana. It was observed that use of human labour generally declined with increase in farm size while that of mechanical labour increased. The share of fixed costs in the total cost of cultivation was higher on large farms than that on small farms. Use of yield augmenting inputs and yield per hectare increased with the increase in farm size and so did the return over variable costs.

Thiruvengkatachari *et al.* (1991) analysed the economics of groundnut production in rainfed area (Tamil Nadu). The study showed that cost A contributed 61.05 per cent to the total cost (cost C) in case of marginal farmers, where as it was 77.27 per cent in the case of big farmers. The net returns over cost C was Rs. 1674, Rs. 2371 and

Rs.2313 in the case of marginal, small and big farmers respectively. It was reported that groundnut production was profitable under rainfed areas of Tamil Nadu.

Mohandas and Thomas (1997) studied the economics of rice production in Kuttanad area of Kerala. They reported that cost of cultivation of paddy for state was Rs. 13,108.05 for marginal farmers (Class I), Rs. 13,309.72 for small farmers (Class II) and Rs. 13,858.13 for large farmers (Class III). Rental value of own land recorded the highest expenditure in Class I and Class II which accounted for 24.19 per cent (Rs. 3,171.30) and 22.38 per cent (Rs. 3,112) respectively. However, the item of highest expenditure was fertilizer in Class III which came to 22.39 per cent (Rs. 3,100.75) of the total cost. Gross returns was highest for marginal farmer (Rs. 15,857 .45) followed by small farmers (Rs. 15,560) and large farmers (Rs. 15,387.50). The net returns and input-output ratio was also found to be highest in marginal farmers (Rs. 2748.95 and Rs. 1.21) followed by small farmers (Rs. 2250.28 and 1.17) and large farmers (Rs. 1529.37 Rs. 1.11).

Narasimham *et al.* (2003) estimated the cost and returns of paddy in Yanam region of Union territory of Pondicherry. They found that the cost of production of paddy per hectare was highest among all the size groups. The total costs per hectare were high in large farms in both crop I (kharif) and crop II (rabi) with Rs. 18,094.26 and Rs. 19,071.29, respectively. Rental value on own land in the cost of production of crop II was more than crop I in all size groups. Gross returns per hectare were the highest on large farms followed by medium and small farms in both crop I and crop II. Net returns also showed direct relation with the farm size.

Tamizheniyam *et al.* (2003) compared the cost of cultivation of IPM demonstration rice plots and non-IPM and rice fields of Tiruvapur district of Tamil Nadu. The per hectare cost of cultivation of IPM fields was Rs. 25,482 with returns of Rs. 41,181 whereas per hectare cost of

cultivation of non-IPM farms was Rs. 26,547.47 with returns of Rs. 37,848.36.

Nasurudeen and Mahesh (2004) compared the economics of rice cultivation in Karaikal region of Pondicherry (UT). They found that total cost per hectare was Rs. 15,040 and Rs. 19735 for direct sown paddy and transplanted paddy, respectively. The yield level was found to be more in the case of transplanted paddy (4185 kg/ha) than that in the direct sown paddy (3590 kg/ha). However, net returns were more for direct sown paddy (Rs. 6500/ha) than for the transplanted paddy (Rs. 5375/ha). In spite of the low yield level direct sown paddy proved to be more profitable as it reduced the requirement of resource and cost of cultivation.

Pouchepparadjou *et al.* (2005) examined the economics of paddy cultivation of IPM adopted and non-adopted farms of Union Territory of Pondicherry. It was observed that the IPM adopted farms generated net returns worth of Rs. 5,208 per acre as against Rs. 4,147 per acre net returns of non-adopted farms, which was 26 per cent higher than the nonadopted farms.

Radha and Chowdry (2005) studied the cost of seed production as well as commercial production of cotton and compared the costs and returns of seed production and commercial production of cotton in Kurnool district of Andhra Pradesh. The cost of cultivation was very high in seed production of cotton (Rs. 74,412/acre) compared to commercial production of cotton (Rs. 26,461/acre). Human labour, manures and fertilizers cost, plant protection chemical cost and rent for leased in land formed major components of total cost in seed production of cotton whereas human labour, plant protection chemicals cost, manures and fertilizers cost and rent for leased in land formed major components of total cost in commercial production of cotton.

Sivanagaraju (2006) studied the cost of cultivation, input utilization pattern, output and returns realized in traditional and SRI

methods of paddy cultivation. Though, per hectare cost of cultivation (Rs.28089) was high, the net returns (Rs. 28877) realized was higher for SRI paddy compared to that of traditional paddy (Rs. 14838) mainly due to high gross returns (Rs.56966) in SRI paddy cultivation where paddy yield harvested in SRI paddy cultivation was more and there was no discrimination between the prices of output of both the methods. It was interesting to note that the returns per rupee spent in traditional paddy was Rs. 1.56 against Rs. 2.02 for SRI paddy farmers mainly because of high gross returns in SRI paddy cultivation.

Basavaraja *et al.* (2008) concluded that, the average of net returns Rs.9,720/ha and Rs.23,593/ha in traditional and SRI methods of rice cultivation. The yield realized in traditional method was 6.07 t/ha and it was 8.51t/ha in SRI method. The expenditure on human and machine labour accounted for the highest share (22.24% and 13.93%, respectively) in the total cost of cultivation of Rs.31,773/ha and Rs.33,1033/ha in traditional and SRI methods in which share of human and machine labour was 28% and 14% respectively.

Barah (2009) it has quantified the cost and returns for SRI and non-SRI practices of rice cultivation in Tamilnadu. The farmer derived multiple benefits from SRI such as higher yield, less input-cost and high income as compared to non SRI farms. On the whole, the combined effect of reduction in cost and higher yield has resulted in increase in net return to the extent of over 31 per cent. The average cost of production has been worked out to be Rs. 269 per quintal of rice under SRI practice and Rs. 365 per quintal under normal practices, an advantage of 26 per cent in cost of production.

A comparison has shown that SRI has higher B-C ratio than that of the conventional practice across the district. The increase in production with reduces cost in most important trait of SRI, which has induced adoption of SRI by the farmers.

Devi and Ponnarasi (2009) it concluded that, the net return has been found higher in SRI (Rs. 27009) than the conventional method (Rs. 14499). The cost of production per tonne of paddy was lower in SRI (Rs. 3937) than the conventional method (Rs. 7404) of rice cultivation. The study has revealed that adoption of SRI technique would help increase rice production without increasing the under cultivation. It has proved to serve as an alternative method for rice cultivation. The increased productivity and net profit would attract the farmers.

Kaul *et al.* (2009) studied economic analysis of productivity and profitability in rice production in India. The study indicated that there has been significant improvement in productivity of rice crop in the beginning of advent of new technology. The total revenue for the crop has been increasing continuously from an average value of Rs. 2360 during 1980-81 to Rs.8890 during 2000-01. However, net revenue was falling and was negative for the year 2000-01. An effort should be made to improve rice productivity to increase profitability and net revenue from the crop and the states like Madhya Pradesh, Rajasthan, Bihar and Orissa showing lower yields be given more attention in this regard.

Rao (2011) it is study that, the dual advantages in the SRI method, viz. reduction in cost of cultivation (Rs 2410/ha) and increase in yields (1.52 t/ha).He also study that cultural practices (20.15%) are major to yield gap than input-use (10.85%) between SRI and traditional methods. SRI is more a skill oriented method than a new technique, and requires clinical precision in management of farm resources. The most important constraint in SRI cultivation has been identified as 'nursery management'.

Haldar *et al.* (2012) studied that, the economic analysis of System of Rice Intensification (SRI) vis-à-vis conventional method of rice cultivation was assessed in Bardhaman district of West Bengal during 2009-10. The cost-returns analysis of SRI method revealed that

the cost of raising nursery for one ha main field transplantation was comparatively lower (Rs. 954 and Rs. 995) than conventional method (Rs.3654 and Rs.4503) in kharif and rabi season, respectively. However, cost of cultivation in SRI method was comparatively higher in kharif (Rs. 44833), but less in rabi season (Rs. 43862) as compared to conventional method (Rs. 40627 and Rs. 44853 in kharif and rabi) of rice cultivation. The total return per rupee of total cost was higher in SRI method (1.58 and 1.92) than in conventional method (1.25 and 1.37) in both the seasons.

Jeen T. Srinivasan (2012) studied an economic analysis of paddy cultivation in the coal land of Kerala. Output has been valued at the procurement price of Rs. 11 per kg. The average net benefit from paddy cultivation is found to be Rs. 11,142 per hectare. This is as low as Rs. 2335 for small padasekharams. While small holder cultivators have a net profit Rs. 27,736 per hectare, it was low as Rs.10279 for marginal holders. We also worked out the ratio of gross value of output and the costs. The ratio was found to be 1.54 for all categories of farmers and ranged from 1.30 for small Padasekharams to 2.58 for small holder cultivators.

The returns to scale indicate that Kole is operating under diminishing returns to scale. Labour cost constitutes over 65 per cent of the total cost of cultivation. Higher inputs of labour are used for certain activities like land preparation, weed removal, transplanting and harvesting. For large number of farmers cultivation of paddy as a single crop itself is not economically viable and may prefer to exist from cultivation.

Shanmugasundaram and Parayil (2012) it is concluded from the study that, SRI techniques is economically feasible as it increases the net income of the farmers. Further the adopters of the demonstration are first time adopters. Hence there is more chance of cost of cultivation getting reduced once the farmers get acquainted with this new practice of rice cultivation. There is considerable scope for

improvement of SRI techniques by incorporating power operated cono weeder which saves the labour problem and the time taken for weeding is also minimized. Imparting skill training to the farmers and Extension personnel is the need of the hour.

Anbarassan *et al.* (2013) the study has revealed that per hectare cost of cultivation is around five per cent lower in SRI than the conventional method. The study also revealed that adoption of SRI has led to 84 per cent increase in net income than conventional method. Net gain from adopting SRI technology was Rs.17045. The contribution of technology for higher yield in SRI has been recorded 40.50 per cent.

2.2 FACTORS CONTRIBUTING TO YIELD DIFFERENCE

Using the output decomposition model many researchers have attempted to quantify the contribution of various sources like difference in technique of production or cultural practices and sub-optimal (differences in the) use of inputs to the productivity difference. Empirical studies attempted to isolate influence of input growth (movement along a production function) and technical changes (shift of a production function) have been reviewed under.

Bisaliah (1977) decomposed the yield difference between the two wheat production technologies in Punjab into its constituent sources. He found that technique of production contributed 15 per cent of the total change in output (40.50%). The increased use of inputs under Mexican wheat contributed about 25.5 per cent to the total difference in output. Among the different inputs the contribution of fertilizer, capital and labour was 15 per cent, 8 per cent and 2 per cent, respectively.

Alshi (1981) studied the impact of technical change on output in cotton economy in Akola district of Maharashtra state. The per hectare production of American cotton and hybrid cotton was 43 per cent and 306 per cent higher than that of desi cotton. The superior cotton cultivation practices followed on American and hybrid cotton farms

accounted for 27.77 per cent and 110.57 per cent, respectively to the total difference in cotton output. The sub-optimal use of the production inputs on desi cotton farms compared to their counterparts on other two categories of farms was responsible for 16.14 per cent (American cotton) and 199.87 per cent (hybrid cotton) of lower output. Among all the inputs the sub-optimal use of capital turned out to be the important source of productivity difference.

Sarup and Pandey (1981) studied the factors responsible for yield gap in wheat. The percentage of area under high yielding varieties of wheat, the percentage of irrigated area and nutrients applied per gross cropped area (kg/ha) were taken as independent variables with the index of potential realization as dependent variable. The highlight of the study was that the percentage of area under high yielding varieties and the application of nutrients have significantly influenced the realization of potential yield on the farmers' field.

Gundurao *et al.* (1985) fitted the Cobb-Douglas type of production function to the field level data while decomposing the yield difference between local and improved varieties of ragi grown in Bangalore district. The improved variety produced about 45 per cent more output than the local variety. Among the different sources, contributing to yield difference, new technology (improved variety) accounted for the highest share (32%) followed by the capital (15%) and the adoption of transplanting method (14%).

Chowdary *et al.* (1993) studied yield gaps in groundnut crop in Ananthapur district of Andhra Pradesh. The reasons for yield gap were analysed through experimental data. The contribution of optimum time of sowing to the productivity was as high as 64.5 per cent of the maximum farm potential. By application of a balanced fertilizer of N and P at the optimum level, the yield could be increased by 53 per cent. Placement of fertilizer through fertilizercum- seed drill or through an attachment to the country seed drill increased the groundnut yield by 18 per cent. The high yielding varieties contributed to the extent of 34

per cent. Forty per cent of the increased yield was obtained by taking plant protection measures. The optimum seed rate of 125 kgs per hectare increased the yield to the extent of about 17 per cent. A clean cultivation was responsible for increasing the yield by 15 per cent.

Thakur and Sinha (1994) examined the impact of technical change in rice production in northern and southern regions of Bihar. The technological bias rice production was found to be land and labour saving as well as fertilizer and capital using in northern region. Whereas it was labour, fertilizer and capital using and land saving in southern region. The authors observed that the contribution of a new rice production technology was more pronounced in southern region as compared to the northern region of the state. The total difference in rice output with the introduction of new technology was 43.47 per cent and 47.77 per cent higher in northern and southern regions, respectively.

Kiresur *et al.* (1996) conclude that, the magnitude of yield or economic returns realized by adopting improved crop production method could be of only limited use in assessing the sustainability of the improved technology. The variations in the yield level realizable from the prevailing farmer's practices and an estimate of the response of the yields or returns from the improved technology to the site index are important factors to be considered for evaluating the sustainability of any improved crop production technology.

Patil *et al.* (1997) analysed the constituent sources of yield gaps in groundnut production in Dharwad district of Karnataka state. Multistage random sampling was used to collect data from 120 sample farmers. The decomposition analysis of productivity difference indicated about 28.69 per cent of yield gap between the potential farms and the sample farms. The contribution of techniques of production to the yield gap was comparatively less (3.42). This meant that there was a limited scope for exploiting the untapped farm potential through better techniques of production. The difference in input use was found to contribute more (25.82%) to the productivity difference. There was a

vast scope for exploiting the greater yield levels on the farmers' field by increasing the use of inputs. The sub-optimal use of human labour contributed for the highest share (14.36%) among all the inputs. However, the contribution of plant protection chemicals was negative. This implied that reduction in the expenditure on this input would result in a higher output on the farmers' field.

Badal and Singh (2001) studied the impact of technological change in maize production in Bihar by using decomposition analysis. The total differences in the productivities per hectare between traditional varieties and high yielding varieties (HYVs) of maize were estimated to be 69 per cent in kharif and 80 per cent in rabi. Thirty per cent of total yield increase was attributed to HYVs technology in kharif maize production and the rest (39 %) was attributed to higher input use level on HYVs maize farms.

Gaddi *et al.* (2002) while studying yield gaps in cotton crop in Dharwad and Bellary districts of Karnataka used the decomposition analysis to assess the contribution of various sources to the yield gap between the farmers' field and the demonstration plots. The decomposition analysis revealed that the difference between the potential farm yield and the actual yield ranged from 42.97 per cent on small farms to 40.97 per cent on large farms (the contribution from difference in input use to the yield gap was 18.39 per cent on small farms to the 10.01 per cent on large farms). The differences in techniques of production between the farmers field and the demonstration plots turned out to be major (24.59 on small farms and 30.96 on large farms) contributor to the yield gap while the input use differences contributed about 18.39 per cent on small farms to 10.01 per cent on large farms. This suggested that there was more scope to raise the cotton productivity by improving the techniques of production rather than by raising the input levels.

Pouchepparadjou *et al.* (2005) while studying the effect of IPM on the output of paddy using decomposition analysis noticed that the

the other hand, FYM (15.19%) and human labour (7.65%) had positive contribution to the productivity difference.

Basavaraja *et al.* (2008) they concluded that, the average of net returns Rs.9,720/ha and Rs.23,593/ha in traditional and SRI methods of rice cultivation. The yield realized in traditional method was 6.07 t/ha and it was 8.51t/ha in SRI method. The expenditure on human and machine labour accounted for the highest share (22.24% and 13.93%, respectively) in the total cost of cultivation of Rs.31,773/ha and Rs.33,1033/ha in traditional and SRI methods in which share of human and machine labour was 28% and 14% respectively.

Barah (2009) it has quantified the benefits of SRI over non-SRI practices of rice cultivation in Tamilnadu. The SRI Practices have been found to save inputs substantially and to increase returns. Higher return has been attributes to increase in production as well as substantial reduction in cost of cultivation. The most impressive are the saving in water (22-39 per cent) and seed (92 per cent). The estimates of technical efficiency using DEAP has clearly shown that SRI is more technical and economic efficient.

Devi and Ponnarasi (2009) it concluded that, the net return has been found higher in SRI (Rs.27009) than the conventional method (Rs.14499). The cost of production per tonne of paddy was lower in SRI (Rs.3937) than the conventional method (Rs.7404) of rice cultivation. The study has revealed that adoption of SRI technique would help increase rice production without increasing the under cultivation. It has proved to serve as an alternative method for rice cultivation. The increased productivity and net profit would attract the farmers.

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major to yield gap than input-use (10.85%) between SRI and traditional method.

Anbarassan *et al.* (2013) a perusal of the results of decomposition analysis revealed that there was not discrepancy between the observed difference (23.25%) and the estimated difference (23.54%) in the productivity of SRI method and traditional method. It can be further inferred that between technological and input use differentials, which together contributed to the total productivity difference of the order of 23.25, the former alone accounted for 21% This implied that paddy productivity could be increased by about 23.54 if the farmers could switch over from traditional method to SRI method with the same level of resource use as in traditional method. An increase in productivity exclusively from technological improvement is brought about through a shift in the scale and/ or slope parameters if the productions function.

The number irrigations are less in SRI than conventional method. It is because of the principle alternate wetting and drying. The average number of irrigation used in the conventional method was 30 and in the SRI it is 20.6.it could be inferred that SRI saves around 30% of water requirement for the cultivation of paddy.

2.3 SRI METHOD IN RICE CULTIVATION

System of Rice intensification (SRI) was a method of raising rice that produces Substantially higher yields with the planting of far fewer seedlings and the use of fewer inputs than either traditional methods (*i.e.*, water) or more "modern" methods (chemical fertilizer or agrochemicals). It involves using different practices for plant, soil, water and nutrient management. This system of Rice intensification has been successfully used in a number of countries.

Nemoto *et al.* (1995) reported that increased occurrence of 4th phylochron depends upon temperature. Tillering and rooting was

reduced if transplanting occurs after 4th phyllochron. This might vary from 8 - 12 atmost 15th days.

Cassman *et al.* (1998) reported that the uptake of N by irrigated rice plant was very 'inefficient' often in the range of on 20 - 30%.

Ramasamy *et al.* (1997) studied the role of cytokinins, growth hormone regulating the cell division in plants. The high yields with "SRI" method were attributable in general terms to the shortened phyllocrans - the greater number of growth cycles completed before anthesis which reflects an accelerated rate of cell division and accelerated biological clock.

Joelibarison (1998) conducted pull test regarding root growth of "SRI" cultivated plants with normal cultivated plants. He observed that under "SRI" conditions single rice plant requires 53 kgs of force when compared with normal conditional rice plant clump of 3 plants which required 28 kg of force.

Bonlieu (1999) found a positive correlation between number of panicles and grains per panicle with "SRI" method of rice cultivation and showed that an average increase in yield was associated with large number of weedings.

Hirsch (2000) revealed that the combination of plant soils, water and nutrients management practices used in "SRI" promoted a) measurably greater root growth b) corresponding observable increase in tillering, with c) resulting in greater grain filling and d) often higher grain weight yields in "SRI" method (8 t/ha) in Madagascar, where the national average was 2 tonnes.

Aziz and Hasan (2000) observed 15 per cent increase in grain weight in "SRI" in Bangladesh.

Laguna (2002) reported that SRI was proved to be an effective water saving technique which incurred (50%) less seed costs and costs

on other inputs. Weeding was easier since the seedlings were distanced further apart.

Stoop *et al.* (2002) reported that the SRI helped resource limited farmers to realize yields upto 15 t/ha on poor soils with no use of external inputs and with greatly reduced rates of irrigation in madagascar.

Uphoff and Fernandes (2002) compiled the main findings and comments reported from SRI adopted countries. Specific advantages mentioned were increased yield levels of 4 – 8 tonnes per hectare, increased returns to labour and environmental benefits, while saving most of the resources. But, requirement of more labour and seedling mortality were reported to be the constraints for SRI method.

Anthofer (2004) studied the performance of SRI cultivation in Cambodia and found that SRI increased yield level from 1629 kg per ha to 2289 kg per ha (41%), while increasing both land and labour productivity and lowering the expenditure on seeds and fertilizers. The per hectare gross margin of SRI was \$120 as against \$209 in conventional method (74% more). Economic risk was also less in SRI to achieve same desired per hectare gross margin than that in conventional method.

Barret *et al.* (2003) analyzed the performance of System of Rice Intensification (SRI) in Madagascar. The results showed that SRI method increased factor productivity by 37.4 per cent, while an additional 49.5 per cent increase was attributable to skillful use of the method.

Kumar and Shivay (2004) reported the benefits associated with the SRI. Greater root growth, increased tillering, increased grain filling, saving in inputs like less water requirement, less seed rate *etc.* and increased factor productivity and profitability were some of the benefits.

Rekha (2004) compared the SRI method of cultivation with the traditional method of cultivation of Njavara, a medicinal rice variety grown in Kerala and found that the yield was increased by three folds under the SRI compared to the yield obtained under traditional method with the net profit of Rs. 80,000 per hectare.

Yang and Suon (2004) reported that SRI method had required 46 per cent lesser seed rate and 50 per cent lesser expenditure on chemical fertilizers, while decreasing 71 per cent labour requirement and increasing 41 – 130 per cent yield as against traditional method.

Rajendra (2005) studied the performance of SRI of (early rice) Bansahan variety in Magan district, Nepal. The per hectare yield of SRI was 8.5 tonnes as against 4 tonnes of traditional method. He observed that SRI required less seed rate (5 – 10 kg) and small quantities of water to achieve the mentioned yield level.

Reddy *et al.* (2005) while comparing the economics of normal rice (transplanted) and SRI method rice found that the total operations cost of SRI method of rice (Rs.9456.29/acre) was higher than the total operational cost of normal rice (Rs. 8235.72/acre). However, net returns per acre were high in the case of SRI method of rice (Rs.7805/acre) than the normal rice (Rs. 5915/acre). The major attributing factor for the high operational cost in SRI method of rice was human labour. The study revealed that the higher total operational costs were compensating the yield advantage of SRI method of rice. Nevertheless, SRI method of rice reduced the water requirement, which was not accountable in the free-regime of power supply to agriculture.

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Barah (2009) it has quantified the benefits of SRI over non-SRI practices of rice cultivation in Tamilnadu. The SRI Practices have been found to save inputs substantially and to increase returns. Higher return has been attributes to increase in production as well as substantial reduction in cost of cultivation. The most impressive are the saving in water (22-39 per cent) and seed (92 per cent). The estimates of technical efficiency using DEAP has clearly shown that SRI is more technical and economic efficient.

Devi and Ponnarasi (2009) the study has revealed that adoption of SRI technique would help increase rice production without increasing the under cultivation. It has proved to serve as an alternative method for rice cultivation. The increased productivity and net profit would attract the farmers. SRI method has lack of skilled labour, awareness, training on new technology and experience has been opined as the main problems in adoption of this technology by the farmers.

Bibhas (2010) a study on the impact of Paddy cultivation through SRI (System of Rice Intensification) was conducted in West Tripura district of Tripura state during the season 2010-11 for both the crop Aman and Boro along with the traditional line sowing method. It was found that the paddy cultivation through SRI method was highly remunerative. It was observed that it generated an additional income of Rs. 1441 over the traditional line sowing method of paddy cultivation (Rs. 4319) for an operational area of 0.2 hectare (an unit of cultivated area followed in the state) resulting an increase of 33.36 per cent more income from SRI method. The inequalities of income distribution among different categories of farm size was found to be maximum in traditional line sowing method as compared to the SRI practicing size groups.

Rao (2011) the study has assessed the economics and sustainability of SRI (system of rice intensification) and traditional methods of paddy cultivation in North Coastal Zone of Andhra Pradesh for the period 2008-09, based on the data of costs and returns of crop. Apart from budgeting techniques, benefit-cost ratio (BCR), yield gap analysis, sustainability index and response priority index have been employed in the study. It has shown that BCR is higher for SRI (1.76) than traditional (1.25) methods. Further, there is a 31 per cent yield gap between SRI and traditional methods, in which cultural practices (20.15%) have shown a stronger effect than input use (10.85%). The most important constraint in SRI cultivation has been identified as 'nursery management'. The SRI method being more skill oriented, the study has observed that yields can be made sustainable if constraints are addressed on war-footing basis.

Weijabhandara *et al.* (2011) to study the influence of nutrient levels on grain yield and nutrient uptake of rice (*Oryza sativa* L.) under system of rice intensification (SRI) and traditional methods of cultivation.

Haldar *et al.* (2012) the economic analysis of System of Rice Intensification (SRI) vis-à-vis conventional method of rice cultivation was assessed in Bardhaman district of West Bengal during 2009-10. The cost-returns analysis of SRI method revealed that the cost of raising nursery for one ha main field transplantation was comparatively lower (Rs 954 and Rs 995) than conventional method (Rs 3654 and Rs 4503) in kharif and rabi season, respectively. However, cost of cultivation in SRI method was comparatively higher in kharif (Rs 44833), but less in rabi season (Rs 43862) as compared to conventional method (Rs 40627 and Rs 44853 in kharif and rabi) of rice cultivation. The total return per rupee of total cost was higher in SRI method (1.58 and 1.92) than in conventional method (1.25 and 1.37) in both the seasons. SRI farmers were found to be technically more efficient than conventional rice farmers. The probability of

adoption increases as the literacy level increases and farmers located far away from canal. Difficulties in management practices like water management, intercultural operations along with lack of skilled labour and water scarcity especially in rabi season were the major factors constraining the adoption of SRI method.

Shanmugasundaram and Parayil (2012) it is study that, SRI techniques is economically feasible as it increases the net income of the farmers. Further the adopters of the demonstration are first time adopters. Hence there is more chance of cost of cultivation getting reduced once the farmers get acquainted with this new practice of rice cultivation. There is considerable scope for improvement of SRI techniques by incorporating power operated cono weeder which saves the labour problem and the time taken for weeding is also minimized. Imparting skill training to the farmers and Extension personnel is the need of the hour.

Palanisami *et al.* (2013) study the System of Rice Intensification is the answer to meet the country's future rice demand. A macro-level study covering 13 major rice-growing states indicates that fields with SRI have a higher average yield compared to non-SRI fields. Out of the four core SRI components typically recommended, 41% adopted one component, 39% adopted two to three components, and only 20% adopted all the components. Full adopters recorded the highest yield increase (31%), but all adopters had yields higher than those that used conventional practices. They also had higher gross margins and lower production costs compared to non-SRI fields. Though the rice yield of the country can significantly increase under SRI and modified SRI practices, there are major constraints that have to be tackled before this can be achieved.

2.4 CONSTRAINTS IN CULTIVATION OF CROP

Thakur and Sharma (1984) reported the weaknesses of the farm sectors responsible for slow progress of agriculture. Irrigation, lack of

High Yielding Varieties seeds, very low use of fertilizers and lack of extension facilities to translate improved technology to farmers' fields were found to be some of the main constraints.

Rangaswamy (1986) identified the constraints inhibiting the utilization of key inputs *viz.*, availability of quality seeds, fertilizers and pesticides in dry farming areas. He reported that the farmers were uncertain about the outcome of crops and felt that they would lose by investing more. He stressed the need for developing suitable strategies to stabilize the farm income in dry areas.

Chitnis and Bhikgaonkar (1987) investigated the major constraints that caused technological gaps in the process of adoption of dry farming technology. Four types of constraints, namely, (1) technology, (2) credit and economic service, (3) supply and (4) information transfer were identified by the authors. They firmly advocated for adequate supply of inputs, timely advice and training through demonstrations.

Shah and Kute (1987) studied the infrastructural constraints of dry farming. They pointed out that farmers lost less by using less amounts of fertilizers and marginal farmers needed very small amounts of fertilizer. Their study emphasized that the need for interaction and effective co-ordination among the technical, financial and administrative personnel for developing rain fed agriculture. Moreover, they opined that the adoption of complementary land based systems like animal husbandry; agro-forestry and poultry would improve the socio-economic well being of the poor farmers.

Vivekananda (1999) opined that agricultural development in Karnataka state had been hindered by the problems such as, weak research, extension network, regional imbalances, and stagnation in area under High Yielding Varieties *etc.*

Chandrashekar *et al.* (2001) listed production constraints faced by growers in the order of importance. They were lack of technical

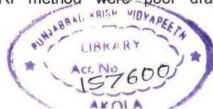
guidance, more pests and diseases, high cost of fertilizers, high cost of plant protection chemicals, non-availability of seed materials and non-availability of fertilizer in time.

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

Rajkumar and Hari Singh (2002) studied problems in vegetable production. The problems reported were, poor quality seeds (42.2%), insufficient availability of seed (40%), high cost of seed (31%) and non-availability of seed at appropriate time (12.2%). The other problems noticed were high cost of fertilizer, poor state of fertilizer and plant protection delivery system in the district. High wages and shortage of labour was also one of the constraints.

Hirala Jana and Verma (2004) conducted a study to know the constraints faced by the growers. The authors identified high cost of chemicals, lack of technical guidance, shortage of labour when needed, high labour charges, non-availability of paddy weeder and non-availability of chemicals as the major constraints.

Sivanagaraju (2006) studied constraints in practicing SRI method of paddy cultivation could be inferred that high labour requirement was observed to be the major constraint for SRI method. Heavy weed infestation was the second next constraint for practicing SRI method of paddy cultivation. Other problems encountered by sample farmers in practicing SRI method were poor drainage



conditions, difficulty in manual conoweeder operation and high cost of cultivation.

Devi and Ponnarasi (2009) he observed that in SRI method has lack of skilled labour, awareness, training on new technology and experience have been opined as the main problems in adoption of this technology by the farmers.

Rao (2011) it is study that, SRI is more a skill oriented method than a new technique, and requires clinical precision in management of farm resources. The most important constraint in SRI cultivation has been identified as 'nursery management'.

Haldar *et al.* (2012) he concluded that, SRI farmers were found to be technically more efficient than conventional rice farmers. The probability of adoption increases as the literacy level increases and farmers located far away from canal. Difficulties in management practices like water management, intercultural operations along with lack of skilled labour and water scarcity especially in rabi season were the major factors constraining the adoption of SRI method.

Shanmugasundaram and Parayil (2012) it is concluded that, considerable scope for improvement of SRI techniques by incorporating power operated cono weeder which saves the labour problem and the time taken for weeding is also minimized. Imparting skill training to the farmers and Extension personnel is the need of the hour.

Palanisami *et al.* (2013) it is concluded that, the major constraints in the adoption of SRI/modified SRI practices are a lack of skilled manpower available in time for planting operations, poor water control in the fields, and unsuitable soils. Farmers felt that the transaction (managerial) cost, though insignificant, also constrains full adoption of SRI. Hence, interventions are necessary to address these constraints.

Chapter III

METHODOLOGY

Adoption of sound Methodology is of vital importance in the economics study. It comprises of collection of data, sampling technique, designing of schedule, analysis of data, presentation and interpretation of result. The different techniques used and methods adopted in this study are described under the following sub heads.

3.1 Sampling Design

The study was based on the input-output data obtained from sample farmers in Bhandara and Chandrapur districts. For selection of farmers, multi-stage sampling design was employed. In this procedure, at first stage, two major paddy growing districts following both traditional and SRI method of rice cultivation were purposively selected. From each district, two major paddy growing Talukas following both the methods of rice cultivation were selected at second stage. Then at third stage, three major paddy growing villages following traditional and SRI methods of rice cultivation were selected from each Talukas. In the final stage, ten farmers were randomly selected from each village comprising five farmers for SRI method and five farmers for traditional method of rice cultivation. Thus, the total sample size was 120. The necessary primary data was obtained from the sample farmer through personal interview with the help of pre-tested and well structured schedule. The data was collected certainly to the Kharif season of the agriculture year 2012-13.

3.2 Nature and Sources of Data

For evaluating the specific objectives of the study, necessary primary data were obtained from the sample farmers through personal interview with the help of pre-tested and well-structured schedule. The data so collected pertained to the kharif season of the agricultural year 2012-13. The data relating to general information about the sample

farmers, their assets position, cropping pattern, details on various inputs used in paddy cultivation like chemical fertilizers, plant protection chemicals, seed materials and labour and cultivation practices such as land preparation, transplanting, irrigation, interculture and harvesting along with labour requirement were collected. The adoption levels of the recommended methods of SRI method of paddy cultivation, its advantages and the constraints for it were also elicited.

Table 3.1 Details of selected village wise farmers and their distribution

Sr. No.	Name of District	Name of Talukas	Name of Villages	No. of farmers
1	Bhandara	Sakoli	Virsi	10
2			Sivnibandh	10
3			Sangadi	10
4		Lakhandur	pimpalgao	10
5			madeghat	10
6			Lakhandur	10
7	Chandrapur	Sindevahi	Kanhalgaon	10
8			Jatlapur tu.	10
9			Sarkada	10
10		Mul	Rajoli	10
11			Mul	10
12			Chirol	10
	Total			120

A list of farmers from the selected villages was obtained. The farmers were categorizing into marginal, small, medium and large on the basis of size of holding. From each village ten cultivators were selected from four size of holding randomly. The details are as below.

3.3 Analytical Tools

For the purpose of achieving the objective of the study .The collected data are subjected to the statistical analysis for this purpose, tabular and production function analysis will be employed.

The techniques of tabular presentation were used to assess the cost, returns and profits of the paddy crop in the study area. The



Location of Bhandara and Chandrapur District in Maharashtra State



BHANDARA DISTRICT

Selected Districts



CHANDRAPUR DISTRICT

Selected Tahsils

Fig. 1. Tahsilwise Map of Bhandara and Chandrapur District

percentage and averages were completed and camped to drown meaning full inferences.

The standard cost concept was used to study the economic analysis of paddy cultivation based on Dr. Sen's committee report (1979) given as follows.

Cost-A1: It includes the value of

- _ Hired Human labour
- _ Bullock power
- _ Machine labour
- _ Seeds
- _ Manures and fertilizers
- _ Irrigation charges
- _ Incidental
- _ Plant protection chemicals
- _ Repairs
- _ Depreciation
- _ Land revenue
- _ Interest on working capital

Cost-A2: Cost A1 + rent paid for leased in land, if any.

Cost-B1: Cost A1 + interest on value of owned fixed capital (other than land).

Cost-B2: Cost-B1 + rental value of owned land + rent paid for leased in land.

Cost-C1: Cost B1 + imputed value of family labour.

Cost-C2: Cost B2 + imputed value of family labour.

In the present study, the rent paid for leased in land was zero, as none of the sample farmers took land on lease basis. Hence, cost

A1 and cost A2 are similar and are simply called as cost-A and only cost-C was estimated in the study and presented in the result.

3.4 Production Function Analysis

The Cobb-Douglas production function is the most widely used from of production functions for filling agricultural production data, because of its mathematical properties like case of interpretation and computational simplicity. In the present study Cobb-Douglas production function in the log form will be used as follows.

$$\ln Y = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + u$$

Where,

Y = Output (yield) quintal/ha.

X₁ = Human labour (mandays/ ha).

X₂ = Seeds kg/ ha.

X₃ = N kg/ ha.

X₄ = P kg/ ha.

X₅ = Farm yard manure in tonnes/ha.

X₆ = Expenditure on plant protection (Rs/ha).

X₇ = Area under paddy cultivation (ha).

Ln = Normal log

b₀ to b₇= Coefficient

U = Error term

The above function was estimated by using OLS method assuming the error term (U) to be randomly and normaly distribution.

The above function was used for both the method of paddy cultivation. SRI and Traditional method, for identify the important

factors affecting production of paddy under both methods. The estimates were further used for decomposition analysis.

3.5 Decomposition analysis

The output decomposition model as developed by Bisaliah (1977) was used for investigative. The contribution of various constituents' sources productivity difference between the SRI method and the traditional method rice cultivation for any two production functions. The total change in the productivity could be brought out by shifts in the production parameter. That defines the production function itself and by change in the input used levels. Therefore the production function will be considered as the convenient econometric tools for decomposing the productivity differences between two methods of cultivation.

In logarithm form, Cobb-Douglas production function for SRI method of paddy is;

$$\ln Y_S = \ln b_{S0} + b_{S1} \ln X_{S1} + b_{S2} \ln X_{S2} + b_{S3} \ln X_{S3} + b_{S4} \ln X_{S4} + b_{S5} \ln X_{S5} + b_{S6} \ln X_{S6} + b_{S7} \ln X_{S7} + U_S \text{ ----- (1)}$$

Logarithm form of Cobb-Douglas production function for traditional method of paddy is;

$$\ln Y_T = \ln b_{T0} + b_{T1} \ln X_{T1} + b_{T2} \ln X_{T2} + b_{T3} \ln X_{T3} + b_{T4} \ln X_{T4} + b_{T5} \ln X_{T5} + b_{T6} \ln X_{T6} + b_{T7} \ln X_{T7} + U_T \text{ -----(2)}$$

Taking differences between (1) and (2) and adding some terms and subtracting the same terms.

$$\ln Y_S - \ln Y_T = (\ln b_{S0} - \ln b_{T0}) + (b_{S1} \ln X_{S1} - b_{T1} \ln X_{T1} + b_{S1} \ln X_{S1} - b_{S1} \ln X_{S1}) + (b_{S2} \ln X_{S2} - b_{T2} \ln X_{T2} + b_{S2} \ln X_{S2} - b_{S2} \ln X_{S2}) + (b_{S3} \ln X_{S3} - b_{T3} \ln X_{T3} + b_{S3} \ln X_{S3} - b_{S3} \ln X_{S3}) + (b_{S4} \ln X_{S4} - b_{T4} \ln X_{T4} + b_{S4} \ln X_{S4} - b_{S4} \ln X_{S4}) + (b_{S5} \ln X_{S5} - b_{T5} \ln X_{T5} + b_{S5} \ln X_{S5} - b_{S5} \ln X_{S5}) + (b_{S6} \ln X_{S6} - b_{T6} \ln X_{T6} + b_{S6} \ln X_{S6} - b_{S6} \ln X_{S6}) + (b_{S7} \ln X_{S7} - b_{T7} \ln X_{T7} + b_{S7} \ln X_{S7} - b_{S7} \ln X_{S7}) + (U_2 - U_1) \text{ -----(3)}$$

By using logarithm rule equation (3) becomes;

$$\ln(Y_S/Y_T) = \{ \ln [b_{S0}/ b_{T0}] \} + \{ (b_{S1} - b_{T1}) \ln X_{S1} + (b_{S2} - b_{T2}) \ln X_{S2} + (b_{S3} - b_{T3}) \ln X_{S3} + (b_{S4} - b_{T4}) \ln X_{S4} + (b_{S5} - b_{T5}) \ln X_{S5} + (b_{S6} - b_{T6}) \ln X_{S6} + (b_{S7} - b_{T7}) \ln X_{S7} \} + \{ b_{S1} \ln (X_{S1}/X_{T1}) + b_{S2} \ln (X_{S2}/X_{T2}) + b_{S3} \ln (X_{S3}/X_{T3}) + b_{S4} \ln (X_{S4}/X_{T4}) + b_{S5} \ln (X_{S5}/X_{T5}) + b_{S6} \ln (X_{S6}/X_{T6}) \} + b_{S7} \ln (X_{S7}/X_{T7}) \} + [(U_2 - U_1)] \text{-----} (4)$$

This is the decomposition model for decomposing the productivity difference between the SRI method and the traditional method of rice cultivation. This equation involves decomposing the logarithm of ratio of per hectare productivity of SRI and traditional method of rice cultivations. This is approximately a measure of percentage change in per hectare output between the SRI cultivation and traditional cultivation.

The summation of first and the second terms on the right hand side of the decomposition model together represented the productivity difference between the SRI method and traditional method, attributable to the difference in the cultural practices. The third term provided the productivity difference between the SRI cultivation and traditional cultivation attributable to the differences in the input use.

3.5 Evaluation of input factors

1. Human labour

It was divided into two i.e. a) hired human labour b) family labour

a) Hired human labour

Actual amount paid both in cash and kind by farmers was noted. Permanent hired labours to which actual amount paid both in cash and kind annually by farmers were also noted.

b) Family labour

The value of family labour was imputed at the existing rate of the attached farm labour. When attached labour was not engaged then it was imputed at the prevailing wage rate of the hired labour from time to time.

2. Bullock Power

Owned bullocks were charged by considering prevailing hiring charges and bullock labour and actual maintenance cost.

3. Seed cost

The actual cost of purchased seed was considered. The owned seeds were charged at prevailing in market price.

4. Manures and fertilizer

The cost of manures and fertilizer applied to the crop were considered. Farm yard manure prepared on farm was evaluated of prevailing market price. The purchased manure and fertilizers were evaluated at the actual price paid by the farmer.

5. Irrigation Charges

Irrigation charges were calculated at the rate of charges actually paid by the cultivators. Regarding electricity, repairs of machinery and the labour charges paid for the irrigation operation.

6. Land Revenue

Land revenue varies according to the fertility of soil. The total land revenue was distributed for each crop according to area under crop.

7. Implement Charges

Hired implement and machinery were considered as per actual charges paid by the cultivator.

8. Interest on working capital

Interest on working capital was estimated at the rate of 6% per annum and for seasonal crops it was considered for the crop duration.

9. Depreciation

It includes depreciation charges and repairing charges of implements and machinery. The depreciation charges on implements, machine and farms building were work out by straight line method. In case of repairs to implements the actual cost incurred was taken into account.

It was calculated by-

$$\frac{\text{Purchased price} - \text{Junk value}}{\text{Expected life}}$$

10. Rental Value of land

Rental value of land means the charges for the use of the land. It was calculated as 1/6 of the total gross value of produce less land revenue.

11. Interest on fixed capital

It was calculated at the rate of 10 per cent per annum.

12. Total cost of cultivation

Cost of cultivation included variable costs and fixed costs. Variable costs included the cost of human labour, bullock power, machine labour, seeds, farmyard manure, plant protection chemicals, irrigation charge and interest on working capital. Fixed costs comprised depreciation, land revenue, rental value of land and interest on fixed capital.

13. Gross returns

Physical quantities of main and by product were noted. It was evaluated at the market price.

14. Net Returns

Net returns at cost 'A', cost 'B', cost 'C' were worked out by deducting the expenditure from the gross income.

Net returns = Gross returns – Gross expenditure

Net returns at cost 'A' = Gross returns – cost 'A'

Net returns at cost 'B' = Gross returns – cost 'B'

Net returns at cost 'C' = Gross returns – cost 'C'

Chapter IV

SOCIO ECONOMIC FEATURE OF BHANDARA AND CHANDRAPUR DISTRICT.

Maharashtra state has six revenue divisions that are viz Mumbai, Nasik, Pune, Aurangabad, Amravati, and Nagpur. Vidarbha area includes Amravati and Nagpur division. Vidarbha as a whole contribute for Cotton, Paddy, Jowar, Oilseeds, Soybean, Citrus crop and Forest timber. The present study confined to Bhandara and Chandrapur district of Eastern Vidarbha.

The current name of Bhandara, is derived from the term 'bhana' meaning 'brass', as the town is dominated by brass-working industry. With more than 3500 small lakes in and around the district, this 'Brass City' is also referred to as 'District of Lakes'. It is characteristic of a mixed economy with agriculture, industries and forest resources contributing to it. Bhandara district is mainly popular for its large production of rice, and is thus termed as the 'Rice Blow of Maharashtra'.

The city of Chandrapur has ancient temples of the goddess Mahakoli and Anchaleshwar, a form of the god shiva. Chandrapur is also known as Chanda. The region is very rich in mineral wealth such as iron ore, limestone and coal. Many cement factories are located in this region. Due to large number of coal mines present around the city, the city also known as 'City of Black Gold'.

The agro climatic conditions differ from place to place. The two places in close infinity may or may not have identical climatic conditions. These variations call for study also provides background for study area. Some of the important aspects of Bhandara and Chandrapur district which would provide useful background for study area and understanding of the salient features of the farmers in the study area.

4.1 Location:

Bhandara and Chandrapur district is located in the eastern edge of Maharashtra in Nagpur division and forms the eastern part of Vidarbha region.

Bhandara comprises 7 tahsils. It lies between $21^{\circ}10'N$ to $35^{\circ}93''$ N latitude and $79^{\circ}39''$ E to $03^{\circ}61''$ E longitude and 288m altitude. Chandrapur comprises 15 tahsils. It lies between $19^{\circ}56'N$ to $07^{\circ}32''$ N latitude and $79^{\circ}16' E$ to $45^{\circ}19''$ E longitude and 193m altitude.

Bhandara and Chandrapur is the eastern most district of the state Maharashtra. Bhandara district is bounded by Nagpur on the western side, Gondia on the eastern side and Chandrapur district on the southern side and Madhya Pradesh on the northern side. Chandrapur districts bounded by Nagpur, Bhandara and Wardha on the northern side. Yavatmal on the western side, Gadchiroli on the eastern side and Adilabad district of Andhra Pradesh on the southern side.

Physiographically Bhandara district is situated in the Wainganga river basin and Chandrapur district is situated in the Wainganga and Wardha river basin. The eastern and western boundaries of the district are well defined by the river Waingangā and Wardha.

Bhandara district covers an area of 9280.0 square kilometer which contribute 2.99 percent of the total area of the state and had population of 15, 85,580 which contribute 3.15 percent of the total population of the state, respectively.

Chandrapur district occupies an area of 11,443 square kilometer which contribute 3.72 percent of the total area of the state and had population of 17, 71,994.

4.2 Climate:

Owing to the geographical location and physical features the climate of district can be classified as tropical hot climate with high range of temperature throughout the year. Primarily there are two prominent seasons on the district the very hot summer and moderate winter. The summer months are very hot and prolonged while winter is short and mild. The southwest monsoon brings lot of rainfall during rainy season and there is no draught prone area in the district.

The temperature starts decreasing from month of October. December is the coldest month. The daily mean temperature starts rising from the month of February and May is the peak summer month when maximum temperature goes up to 43 and minimum temperature is 28 to 29.

The south west monsoon season is from June to September. The average annual rainfall Bhandara district is about 1361 and Chandrapur is about 1214 mm. the eastern part receives more rainfall than west. Average no. of rainy days is 60 to 65 throughout the district. The relative humidity is very high during monsoon season which exceeds 70 percent but after monsoon season it fall down rapidly and in summer it is only 20 percent.

4.3 Topography of the soil:

Bandara district shallow to deep loamy to clay mixed red and black soil. The soils of the district are highly varied, arising out of the tropical sub-humid weathering of crystalline metamorphic and igneous rocks. They are essentially residual, though along the southern extremes of the Wainganga valley, downstream of Pauni, alluvial soils predominate.

Kali or black regur soils derived from the weathering of basalts are generally rare in the district. Kanhar or very rich alluvial soils occur widely; these soils crumble readily and are easy to work. They are clay

loams in texture, very deep, sticky and retentive of moisture; they bear double crops. Morand soils are coarser in texture and occur farther away from the rivers, in relatively higher ground in comparison to the Kanhar soils. They generally have an admixture of sands or lime or both. The Kanhar and morand soils are chiefly found in the plains of the Wainganga, south of Bhandara and in the lower Chulband valley.

The khardi soils are dark in colour with a considerable admixture of lime; they are generally gravelly and shallow. They are poor soils. The sihar, is a reddish yellow soil derived from crystalline rocks as a result of oxidation under tropical humid conditions and cracks very little in the hot weather. It degrades into the khardi. Most of the cultivable soils of the district belong to the morand and sihar types, both of which are light and slightly acidic. The sihar are the best rice soils of the district while the morand soils are devoted to rabi crops like wheat and linseed and kharif jowar. Poor lateritic bardi soils are found in foothills and sloping areas. Along the immediate banks of rivers, black kachhar soils, reddish and sandy marhani soils, and sandy retari soils are found; these soils are mostly immature. The marhani soils are devoted to garden crops.

Chandrapur district has an elevation between 250 meter above mean sea level. Chandrapur district can be divided in to two regions on the basis of district physiographic features:-

1. The plain of fertile region lying in river valley of the Wardha, the Penganga and the Wainganga River. The widely spread and flat terrain exhibits mostly rolling topography with residual knolls of the hills in the southern portion while in the northern portion that is Brahmपुरi tahsil, fairly wide flood and alluvial plains covered with fertile loams are observed. The flat terrain of Chandrapur district on the whole lies generally between 250 meter. In the Penganga valley, flat terrain covers very little area in parts of the district in Rajura and Chandrapur tahsil exhibits mostly hilly topography. The hills are known as

gadchandur and Manikgarh hills the altitude in general rises to 500 meter above mean sea level.

2. The upland hill region lies between the Wardha and Wainganga river commpairising parts of Worora, Chandrapur and major part of Brahmapuri tahsils. It has sandy soils. The soil of the district is well defined and conductive for growing crops of various kinds. The most fertile soil is found in the Wardha and Wainganga valley. The various kinds of soil known as local name 'kali kanahar', murmad, kardi, wardi, pandhri and retari.

4.4 Agriculture:

Agriculture is the most important economic activity in the Bhandara and Chandrapur district. Kharif and rabi are two seasons followed in the district. The kharif season commences with advent of the rains in the month of June and is followed by rabi season (winter month).

4.4.1 Crops and cropping pattern

The total area as well as relative area under different crops in Bhandara and Chandrapur district for 2011- 12 is presented in Table 4.1

Table 4.1. Cropping pattern of Bhandara District (2011-12)

Name of crop	Area "00" ha
Kh. Rice	1784
Summer Rice	39
Wheat	88
Kh. Jowar	0
Rb. Jowar	8
Kh. Maize	0
Tur	90
Moong	1
Urid	1
Other kh.pulses	0
Gram	36
Other Rb.pulses	2

Kh. G.nut	0
Summer G.nut	2
Rb. Sunflower	0
Summer Sunflower	1
Soybean	70
Linseed	36
Rapeseed & mustard	0
Sugarcane	55
Lakhori	83

Table 4.2 Cropping pattern of Chandrapur District (2011-12)

Name of crop	Area "00" ha
Kh. Rice	1426
Summer Rice	19
Wheat	305
Kh. Jowar	97
Rb. Jowar	207
Kh. Maize	0
Tur	262
Moong	8
Urid	4
Other kh.pulses	18
Gram	252
Other Rb.pulses	322
Kh. G.nut	0
Summer G.nut	1
Rb. Sunflower	0
Summer Sunflower	0
Soybean	1595
Linseed	260
Rapeseed & mustard	0
Sugarcane	0
Cotton	496
Lakhori	147

4.4.2 Land use pattern:

Land use pattern shows that geographical area of Bhandara district is 342 hectare and net cultivated area is 178.3 hectare of the total geographical area. The pattern of land utilization in the district reflects the cultivation potential of the district and also the extent to which it can fully explained.

Table 4.3 Land use pattern of Bhandara district (2011-12).

Particulars	Total area ("000"ha)	Per cent to total geographical area
Total geographical area	342	100
Area under forest	62	18.13
Nonagricultural land	36.9	10.79
Barren and uncultivated land	4.8	1.40
Cultivated waste	11.8	3.45
Permanent pasture and grazing	33.5	9.80
Land under miscellaneous crops	7.7	2.25
Current fallow	5.0	1.46
Other fallow	2.0	0.58
Net sown area	178.3	52.14
Area sown more than once	64.9	
Gross cropped area	243.2	
Cropping intensity	136.4	

Source: District socio-economic review of respective district pub.by Govt. of M.S,Mumbai

Land use pattern shows that geographical area of Chandrapur district is 1092 hectare and net cultivated area is 451.5 hectare of the total geographical area. The pattern of land utilization in the district reflects the cultivation potential of the district and also the extent to which it can fully explained.

Table 4.4 Land use pattern of Chandrapur district (2011-12).

Particulars	Total area ("000"ha)	Per cent to total geographical area
Total geographical area	1092	100
Area under forest	388.2	35.55
Non agricultural land	91.7	8.39
Barren and uncultivated land	26.3	2.39
Cultivated waste	36.6	3.35
Permanent pasture and grazing	56.0	5.12
Land under miscellaneous crops	12.0	1.09
Current fallow	16.0	1.46
Other fallow	13.6	1.24
Net sown area	451.5	41.35
Area sown more than once	80.6	
Gross cropped area	532.1	
Cropping intensity	117.8	

Source: District socio-economic review of respective district pub.by Govt. of M.S,Mumbai

4.4.3. Cropping pattern of Selected Tahsil :

The total area as well as relative area under different crops in selected tahsil of Bhandara and Chandrapur district for 2011-12 is presented in Table 4.5.

Table 4.5 Cropping pattern of Selected Tahsil (2011-12):

(Area in ha)

Sr. No.	Name of crop	Sakoli	Lakhanndur	Sindevahi	Mul
1.	Paddy	18171	23364	18800	7455
2.	Jowar	-	-	-	-
4.	Maize	-	-	-	-
5.	Wheat	100	1100	180	194
6.	Rabi Jowar	0	10	55	417
6.	Tur	1000	1500	700	600
7.	Moong	50	0	-	-
8.	Udid	0	50	-	-
9.	Gram	800	400	140	235
10.	Other pulses	0	0	0	40
11.	Sesamum	0	100	100	45
12.	Soybean	0	800	100	2950
13.	Linseed	990	200	7	48
14.	Lakholi	2000	2500	-	-

Source: Joint Director of Divisional Agriculture Office, Bhandara and Chandrapur.

4.4.4 Land utilization:

It is more or less a mixed tract. Western tract of the district is grows Paddy, Cotton, Jowar and Soybean thus it forms a mixed tract.

Paddy and Cotton are main food and cash crops of the district. Jowar has the fixed position followed by Cotton crops in the cropping pattern of the district. After taking paddy, wheat and gram taken in the region amongst the majority cultivators. Wherever there is an assured irrigation. Soybean cultivation in kharif season.

4.4.5 Crop rotation:

The district has two agricultural seasons viz. Kharif and Rabi. The main crops grown in Kharif season are Paddy, Soybean, Cotton, Tur while Wheat, Gram, rabi Jowar, linseed are the main rabi crops. The perennial crops like Mango and Lemon are also grown. Now farmers of the region are shifted towards growing forest trees.

4.5 Transport and communication:

Bhandara and Chandrapur district is well connected with railways, bus and truck transport. All the tahsils places are well connected to district headquarters. The agricultural and industrial products are quickly transported to the district and States by trucks and railways.

4.6 Input supply:

The farm inputs are made available to the farmers by the co-operative society functioning at the tahsil level as well as village. The loan is provided by the DCCB to the cultivators. The short term loan is made available by the DCCB while long term loan are provided by LDB and the commercial banks.

RESULTS AND DISCUSSION

The study deals with economic analysis of Traditional and SRI method of paddy cultivation base in order to meet the objectives of the study. Data were analyzed for the year 2012-13 and the major findings of this study are presented in this chapter.

5.1 Socio economic characteristics of selected farmers

A study on some socio-economic aspects such as age education, size of family, annual income, farm size and cost of cultivation is necessary to know the economic condition of the farmers.

5.1.1 Average age of selected farmers

Age is important factor, which determines the role of farmers in adoption of improved practices. The distribution of the respondents according to age was ascertained and has been presented in Table 5.1.

Table 5.1 Average age of selected farmers

Sr. No.	Particulars	Traditional (N=60)	SRI (N=60)
1	Bellow 30 (Young)	4 (6.67)	4 (6.67)
2	31 to 60 (Middle)	53 (88.33)	50 (83.33)
3	Above 60 (Old)	3 (5.00)	6 (10.00)
	Average age	44.32	44.70

(Figures in parentheses indicate percentage to the total sample)

The average age of selected farmers this revealed that more than 80 per cent farmers in middle age group in traditional and SRI methods. In old age group 5 per cent farmers and 10 per cent farmers

in traditional and SRI method. Only, 6.67 per cent farmers to young group in both methods. The average age of farmers 44 years in both methods.

5.1.2 Educational status of selected farmers

Education is an important factor in understanding importance and availability of new technology and its adoption. It is also one of the important aspects which affect the standard of living of farmers. The information regarding the educational status of selected farmers is presented in Table 5.2.

Table 5.2 Educational status of selected farmers

Sr. No.	Particulars	(Nos.)	
		Traditional (N=60)	SRI (N=60)
1	Illiterate	10 (16.67)	7 (11.67)
2	Primary school (1-4)	6 (10.00)	6 (10.00)
3	Secondary school (5-9)	14 (23.33)	10 (16.67)
4	High school (10-12)	26 (43.33)	32 (53.33)
5	College (above 12)	4 (6.67)	5 (8.33)
	Average education	7.9	8.8

(Figures in parentheses indicate percentage to the total sample)

It is evident from Table 5.2 that, In traditional method 43.33 per cent of the respondents were educated up to high school, followed by 23.33 per cent respondents were educated secondary school level; whereas 6.67 per cent of them were educated above the college level. Further, it was found that 10.00 per cent respondents were educated up to primary school and 16.67 per cent respondents in the study area were observed under illiterate category in traditional method. In SRI method 53.33 per cent of the respondents were educated up to high school, followed by 16.67 per cent respondents were educated

secondary school level; whereas 8.33 per cent of them were educated above the college level. Further, it was found that 10.00 per cent respondents were educated up to primary school and 11.67 per cent respondents in the study area were observed under illiterate category in SRI method. The average education of 8 standards in both methods.

It can be concluded from the above findings that most of the paddy growers were educated up to high school followed by secondary school level of education.

5.1.3 Average size of family of selected farmers

Family size and its components are basically the functions of economic and social characteristics, custom and religious belief of society. The study of size of family will help us to get an idea about labour force available for farm operation from the family. The details of family size of selected farmers are presented in Table 5.3.

Table 5.3 Average size of family of selected farmers

(Nos.)

Sr. No.	Particulars	Traditional (N=60)	SRI (N=60)
1	Family size		
I	Small (< 5)	24 (40.00)	31 (51.67)
II	Medium (5-10)	33 (55.00)	27 (45.00)
III	Large (> 10)	3 (5.00)	2 (3.33)
2	Type of family		
I	Nuclear family	55 (91.66)	57 (95.00)
II	Joint family	5 (8.34)	3 (5.00)
	Average size	6.00	5.00

(Figures in parentheses indicate percentage to the total sample)

It is revealed from the Table 5.3 that, family size is a major factor in determining the economic well being of the farmers. The family size distribution showed that 40.00 per cent and 51.67 percent

had small family in both methods. However, 55.00 per cent and 45.00 per cent in medium size of family in both methods respectively. Whereas on an average family size 5.00 percent farmers and 3.33 per cent farmers, large size of holding was observed in the sample.

In the type of family about 90 per cent farmers in nuclear family in both methods. Whereas in joint family the 8.34 per cent farmers in traditional method and 5.00 per cent farmer in SRI method.

5.1.4 Family income of selected farmers

The details of family income of selected farmers are presented in Table 5.4.

Table 5.4 Family income of selected farmers

Sr. No.	Particulars	Traditional (N=60)	SRI (N=60)
1	Low (< 50,000)	44 (73.33)	40 (66.67)
2	Medium (51,000-2 lakh)	16 (26.67)	20 (33.33)
3	High(> 2 lakh)	0 (0.00)	0 (0.00)
	Average income	37,350	38,467

(Figures in parentheses indicate percentage to the total sample)

The income group wise farmers were classified and presented in Table 5.4. Which revealed that more than 73.33 per cent farmer were low income group in traditional method and 66.67 per cent farmer in SRI method. However, 26.67 per cent farmers were categorized under medium income group in traditional method and 33.33 per cent farmer in SRI method. The respondents having annual income Rs. 37,350 and Rs. 38,467 in traditional method and in SRI method.

5.1.5 Size of holding of selected farmers

Size of holding indicates the area of land actually holding in different size of group. The Table 5.5 present per farm land utilization pattern of selected farmers.

Table 5.5 Size of holding of selected farmers

Sr. No.	Particulars	Traditional (N=60)	SRI (N=60)
1	Marginal (< 1.0)	28 (46.67)	37 (61.67)
2	Small (1.01-2.0)	18 (30.00)	18 (30.00)
3	Medium (2.01-4.0)	9 (15.00)	5 (8.33)
4	Large (> 4.01)	5 (8.33)	0 (0.00)

(Figures in parentheses indicate percentage to the total sample)

It is revealed from the Table 5.5 that, the average size of holding for marginal, small, medium and large farmer were 46.67 per cent, 30.00 per cent, 15.00 per cent and 8.33 per cent in traditional method. However, the average size of holding for marginal, small and medium farmer were 61.67 per cent, 30.00 per cent, 8.00 per cent, 8.33 per and zero per cent large size of holding in SRI method.

5.1.6 Land utilization pattern of selected farmers

Land utilization indicates the area of land actually utilized in different purpose like crop production, irrigated, un-irrigated, etc. The Table 5.6 present per farm land utilization pattern of selected farmers.

It is revealed from Table 5.6 that, the average size of holding was 1.66 hectares in traditional method and 1.23 hectares in SRI method. However, the net cultivated area was 1.54 hectares and 1.17 hectares in traditional method and SRI method respectively. The percentage of cultivable land was more in case traditional method i.e. 92.77 per cent. While the proportion of area sown more than once was

more in case of SRI method i.e. 36.58 per cent. The intensity of cropping was worked out 125.97 per cent in traditional method. The intensity of cropping is higher on SRI method 138.46 per cent because of more intensive use of land.

Table 5.6 Land utilization pattern of selected farmers

(Area in ha)			
Sr. No.	Particulars	Traditional	SRI
1	Total land holding	1.66 (100.00)	1.23 (100.00)
2	Leased out	0.06 (3.61)	0.01 (0.81)
3	Permanent fallow	0.04 (2.41)	0.17 (13.82)
4	Current fallow	0.02 (1.21)	0.16 (13.01)
5	Net cultivated area	1.54 (92.77)	0.89 (72.36)
6	Area sown more than once	0.4 (24.09)	0.45 (36.58)
7	Gross crop area	1.94	1.62
8	Cropping intensity (%)	125.97	182.02

(Figures in parentheses indicate percentage to average size of holding)

5.1.7 Cropping pattern of selected farmers

Cropping pattern of selected farmers is said to be the result during post experience of farming, the type of soil available, irrigation resources and the pattern of distribution of rainfall. The cropping pattern refers to the proportion of the area under different crops.

It is revealed from Table 5.7 that, in kharif season the cropping pattern in all groups was dominated by paddy crop. The average area under kharif crop was 1.54 hectares (79.38 per cent) while the area under rabi crop was 0.25 hectares (12.89 per cent) in traditional method and the average area under kharif crop was 1.18 hectares (72.84 per cent) while the area under rabi crop was 0.25 hectares (15.43 per cent) in SRI method. The lakhori and wheat were major

crops in selected sample farmers. The share of Paddy in gross cropped area was the highest in traditional method (75.26 per cent) and SRI method was (70.99 per cent). At the kharif season, the highest area occupied by paddy (94.80 per cent) followed by tur (3.90 per cent) and soybean (1.30 per cent) in traditional method while in SRI method was paddy occupied the area (97.45 per cent) followed by tur (2.54 per cent). In the rabi season lakhori occupied highest area followed by other pulses which includes wal, udid, pea. At the share of paddy was (7.73 per cent) in traditional method and SRI method was (11.73 per cent) in summer season. It is concluded from the above discussion that, in kharif season the cropping pattern was dominated by paddy crop where as in rabi season, it was dominated by lakhori crop in both method.

Table 5.7 Cropping pattern of selected farmers

(Area in ha)

Sr. No.	Particulars	Traditional	SRI
A	Kharif crops		
1	Paddy	1.46 (75.26)	1.15 (70.99)
2	Tur	0.06 (3.09)	0.03 (1.85)
3	Soybean	0.02 (1.03)	0.00 (0.00)
	Total	1.54 (79.38)	1.18 (72.84)
B	Rabi crop		
1	Wheat	0.06 (3.10)	0.09 (5.56)
2	Lakhori	0.16 (8.25)	0.12 (7.41)
3	Gram	0.03 (1.54)	0.04 (2.46)
	Total	0.25 (12.89)	0.25 (15.43)
C	Summer crops		
1	Paddy	0.15 (7.73)	0.19 (11.73)
	Gross cropped area	1.94 (100.00)	1.62 (100.00)

(Figures in parentheses indicate percentage to gross cropped area)

5.2 Nursery cost in Traditional and SRI methods of paddy production

As there was difference in nursery management between traditional and SRI methods, resource use pattern and the expenditure made on the various inputs were analysed and the same are presented in Table 5.8

Table 5.8 Nursery cost in Traditional and SRI methods of selected farmers

Sr. No.	Particulars	Traditional Method		SRI Method	
		Quantity	Value (Rs.)	Quantity	Value (Rs.)
1	Seed (Kg.)	48.23	1194.79 (62.83)	6.36	174.11 (26.96)
2	N (Kg.)	6.58	85.86 (4.51)	4.07	53.04 (8.21)
3	Plant Protection Chemicals (gm.)	57.78	189.16 (9.95)	11.92	29.79 (4.61)
4	Labour (mandays)	2.82	431.62 (22.71)	2.46	388.88 (60.22)
	Total		1901.67		645.82

Note: 1) Figures in parentheses indicate percentage to the total

2) Area of nursery plot is 7.20 cents for traditional method and 4.62 cent for SRI method per hectare.

Traditional paddy farmers have used 48.23 kg of seed, 6.58 kg of fertilizer, 57.78 gm. of PPC and 2.82 mandays of human labour as against 6.36 kg of seed, 11.92 gm. of PPC and 2.6 mandays of human labour used by SRI paddy farmers.

The major expenditure item of nursery cost was expenditure made on seeds in traditional paddy (Rs. 1194.79) and SRI paddy (Rs. 174.11). The expenditure made on PPC (Rs.189.16) and labour (Rs.431.62) in traditional nursery management was higher than those in SRI nursery management (Rs.29.79 and Rs.388.88, respectively). The total nursery cost in traditional method (Rs.1901.67) was clearly

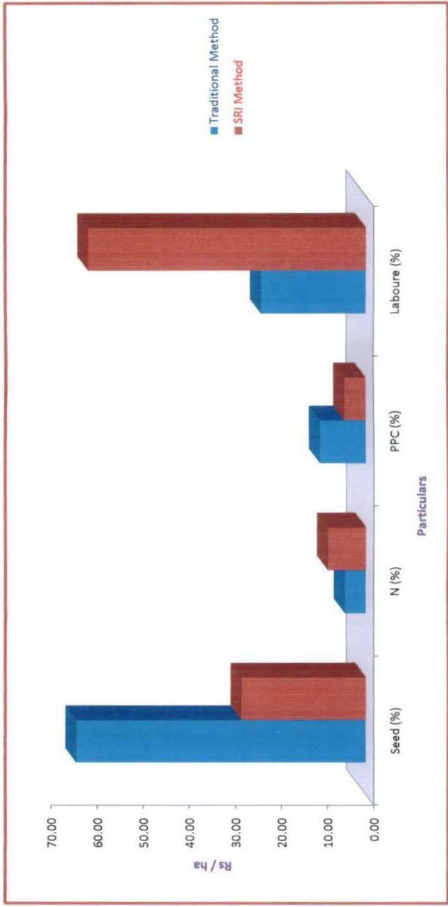


Fig.2: Nursery cost for traditional paddy and SRI paddy

higher than the total nursery cost in SRI method (Rs. 645.82). The share of seed was 62.83 per cent contributing largely to the higher total nursery cost in traditional method. In SRI method also the expenditure on seeds accounted to a share (26.96 per cent). In the traditional method, the share of fertilizer in total nursery cost was lowest 4.52 per cent and 8.21 per cent in SRI method, respectively. In the SRI method the share of PPC in total nursery cost was lowest 4.61 per cent and 9.95 per cent in traditional method.

5.3 Per hectare cost of Cultivation in Traditional and SRI methods of paddy cultivation

The profitability aspect of both the methods of paddy cultivation in the study area has been analysed by computing per hectare cost and returns. The pattern of inputs used in both the methods of paddy cultivation for sample farmers is depicted in Table 5.9 and 5.10. A glance at the table indicated that farmers of traditional paddy were found to use more of seeds (48.24 kg), N nutrient (90.12 kg), P nutrient (34.69 kg) and K nutrient (5.42 kg) as against 6.36 kg of seeds, 84.10 kg of N nutrient, 30.74 kg of P nutrient and 4.10 kg of K nutrient by SRI paddy farmers. However, SRI paddy farmers used 143.55 mandays of human labour, 5.44 pair days of bullock labour, 24.70 hours of machine labour and 63.78 qt. of farm yard manure, which were more against 128.51 mandays of human labour, 6.56 pair days of bullock power, 28.83 hours of machine labour used by traditional paddy farmers. Irrigation charges, land revenue, depreciation and interest on fixed capital were found to be more for traditional paddy farmers, whereas interest on working capital, repairs, incidental and rental value of land was found to be more for SRI paddy farmers.

The per hectare cost of cultivation (Rs. 54330.85) for SRI paddy was more when compared to that (Rs. 46671.10) of traditional paddy.

5.9. Per hectare cost of cultivation for paddy crop (Traditional)

SR. No.	I T E M		UNITS	UNITS	PRICE	COST IN	PERCENT
				Required	PER UNIT	RS.	TO TOTAL
1	Hired Human Labour	Male	Days	16.83	182.10	3064.74	6.57
		Female	Days	87.68	106.31	9321.26	19.97
		Total	Days	104.51		12386.00	26.54
2	Bullock Power	Hired	Days	3.10	249.60	773.76	1.66
		Owned	Days	3.46	249.60	863.62	1.85
		Total	Days	6.56		1637.38	3.51
3	Machine	Hired	Hrs.	27.86	217.66	6064.01	12.99
		Owned	Hrs.	0.97	217.66	211.13	0.45
		Total	Hrs.	28.83		6275.14	13.45
4	Seed		Kg.	48.24	24.77	1194.90	2.56
5	Manure		Qt.	41.20	65.82	2711.78	5.81
6	Fertilizer	N	Kg.	90.12	23.36	2105.20	4.51
		P	Kg.	34.69	26.71	926.57	1.99
		K	Kg.	5.42	27.54	149.27	0.32
		Total		130.23		3181.04	6.82
7	Irrigation		Rs.		456.99	0.98	
8	Incidental		Rs.		37.09	0.08	
9	Plant protection		Rs.		1791.53	3.84	
10	Repairs		Rs.		69.35	0.15	
11	Working Capital		Rs.		29741.21	63.73	
12	Depreciation		Rs.		185.60	0.40	
13	Land Revenue		Rs.		79.40	0.17	
14	Int. On Working Capital		Rs.		594.82	1.27	
15	COST "A"		Rs.		30601.03	65.57	
16	Int. On Fixed Capital		Rs.		434.77	0.93	
17	COST "B1"		Rs.		31035.80	66.50	
18	Rental Value of Land		Rs.		11956.86	25.62	
19	COST "B2"				42992.66	92.12	
20	Family Labour Charges	Male	Days	14.87	182.10	2707.82	5.80
		Female	Days	9.13	106.31	970.610	2.08
		Total	Days	24.00		3678.437	7.88
21	COST "C"		Rs.		46671.10	100.00	
22	Yield	Main	Qt.	42.91	1652.83	70922.94	
		By	Qt.	55.42	23.36	1294.611	
23	Value of Total Produce		Rs.		72217.55		
24	Per Qt. Cost of Production				1057.48		

(Figures in parentheses indicate percentage to the Cost-C)



Table 5.10. Per hectare cost of cultivation for paddy crop (SRI)

SR. No.	I T E M		UNITS	UNITS	PRICE	COST IN	PERCENT
				Required	PER UNIT	RS.	TO TOTAL
1	Hired Human Labour	Male	Days	24.70	183.04	4521.09	8.32
		Female	Days	88.92	107.44	9553.56	17.58
		Total	Days	113.62		14074.65	25.91
2	Bullock Power	Hired	Days	2.46	234.60	577.12	1.06
		Owned	Days	2.98	234.60	699.11	1.29
		Total	Days	5.44		1276.22	2.35
3	Machine	Hired	Hrs.	23.83	243.62	5805.46	10.69
		Owned	Hrs.	0.87	243.62	211.95	0.39
		Total	Hrs.	24.70		6017.41	11.08
4	Seed		Kg.	6.36	27.36	174.01	0.32
5	Manure		Qt.	63.78	70.00	4464.60	8.22
6	Fertilizer	N	Kg.	84.10	23.50	1976.35	3.64
		P	Kg.	30.74	36.45	1120.47	2.06
		K	Kg.	4.10	34.25	140.43	0.26
		Total		118.94		3237.25	5.96
7	Irrigation		Rs.		310.52	0.57	
8	Incidental		Rs.		48.12	0.09	
9	Plant protection		Rs.		1504.66	2.77	
10	Repairs		Rs.		76.25	0.14	
11	Working Capital		Rs.		31183.70	57.40	
12	Depreciation		Rs.		171.27	0.32	
13	Land Revenue		Rs.		61.30	0.11	
14	Int. On Working Capital		Rs.		623.67	1.15	
15	COST "A"		Rs.		32039.94	58.97	
16	Int. On Fixed Capital		Rs.		434.77	0.80	
17	COST "B1"		Rs.		32474.71	59.77	
18	Rental Value of Land		Rs.		17297.05	31.84	
19	COST "B2"				49771.76	91.61	
20	Family Labour Charges	Male	Days	17.77	183.04	3252.621	5.99
		Female	Days	12.16	107.44	1306.47	2.40
		Total	Days	29.93		4559.09	8.39
21	COST "C"		Rs.		54330.85	100.00	
22	Yield	Main	Qt.	57.30	1784.00	102223.2	
		By	Qt.	72.85	26.45	1926.88	
23	Value of Total Produce		Rs.		104150.1		
24	Per Qt. Cost of Production				914.55		

(Figures in parentheses indicate percentage to the Cost-C)

The share of higher human labour in total cost was 26.54 per cent (Rs. 12386.00) for traditional paddy farmers and 25.91 per cent (Rs.14074.65) for SRI paddy farmers. The expenditure made on machine labour was 13.45 per cent and 11.08 per cent respectively for traditional paddy farmers and SRI paddy farmers. The next important item of expenditure in both the methods of paddy cultivation was the expenditure made on fertilizers, which worked out to be 6.82 per cent and 5.96 per cent, respectively for traditional and SRI paddy farmers. The rental value of land was the major expenditure contributing to the fixed cost (25.62 per cent and 31.84 per cent, respectively for traditional paddy farmers and SRI paddy farmers). The share of variable cost was 65.57 per cent (Rs. 30601.03) to the total cost in traditional paddy and 58.97 per cent (Rs. 32039.94) in SRI paddy cultivation. The variable cost was found to be less by about Rs. 1438.91 in traditional method, when compared to that in SRI method. The per quintal cost of production was Rs. 1057.48 for traditional method and Rs. 914.55 for SRI method.

Table 5.11: Per hectare cost and returns from paddy cultivation

Sr. No.	Items	Traditional method	SRI method
1	Gross Return	72217.55	104150.08
I	Yield Qt./ha		
A	Main produce	42.91	57.30
B	By produce	55.42	72.85
II	Price Rs/qt.		
A	Main produce	1652.83	1784.00
B	By produce	23.36	26.45
2	Total Cost		
I	Cost A	30601.03	32039.94
II	Cost B	42992.66	49771.76
III	Cost C	46671.10	54330.85
3	Net Return		
I	Cost A	41616.51	72110.14
II	Cost B	29224.89	54378.32
III	Cost C	25546.45	49771.76
4	Input - Output Ratio		
I	Cost A	2.36	3.25
II	Cost B	1.68	2.09
III	Cost C	1.55	1.92

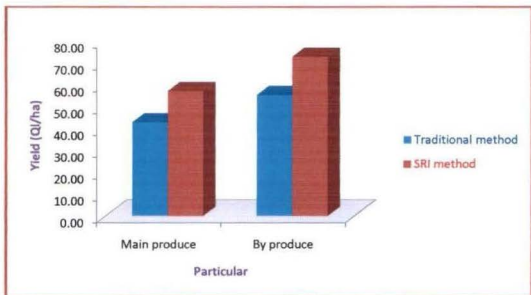


Fig.3: Method-wise paddy productivity

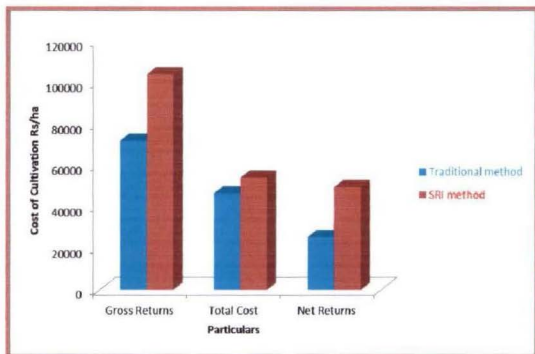


Fig.4: Cost and returns in traditional and SRI method of paddy cultivation

The per hectare paddy output obtained in both the methods is presented in Table 5.11 & Fig.3. The yield per hectare realized in traditional method was 42.91 quintals. The paddy yield realized by SRI paddy farmers was 57.30 quintals per hectare. There was a glaring difference between the two methods in the paddy straw yield. Traditional paddy farmers obtained 55.42 quintals per hectare and SRI paddy farmers realized 72.85 quintals per hectare.

The method-wise cost and return structure in paddy cultivation in study area is given in Table 5.11 and Fig.4. The per hectare cost A, cost B and cost C for SRI method were more when compared to that in traditional method. For example, Cost C was more by about Rs.7659.75 for SRI when compared to that in traditional method. The per hectare gross returns realized for traditional paddy farmers and SRI paddy farmers, respectively were Rs. 104150.08 and Rs. 72217.55.

The net returns (returns over Cost C) were Rs. 25546.45 for traditional method and Rs. 49771.76 for SRI method. The returns per rupee spent were around Rs. 1.55 in traditional method and it was 1.92 in SRI method.

5.4 Decomposition of input utilization for traditional method and SRI method of paddy crop

The degree of management of the resources can be judged for the utilization of resources, the choice and the decision making. Beside this, it also indicates the level of technology adopted by the farmers. The farmers required to spend on various inputs like seed, manure, fertilizer, PPC, human labour and bullock labour. Therefore, it is necessary to know the pattern of expenditure on various inputs on per hectare basis.

Decomposition of inputs utilization in paddy production is presented in Table 5.6. In traditional method per hectare human labour utilization was 128.51 human days, bullock power 6.56 days, machine

labour 28.83 hrs, seeds was 48.24 kg, FYM 41.20 qt, PPC 1571.52 ml and fertilizer 90.13 kg N, 34.69 kg P and 5.42 kg K, respectively.

In SRI method per hectare human labour utilization was 143.55 human days, bullock labour 5.44 days, machine labour 24.70 hrs, seeds was 6.36 kg, FYM 63.78 qtl, PPC 1446.79 ml and fertilizer 84.10 kg N, 30.74 kg P and 4.10 kg K, respectively.

Among the various sources responsible for total productivity difference. The different inputs contributing to the productivity difference between SRI method and traditional method. This implied that farmers growing SRI method paddy obtained higher output per hectare than that obtained by the farmers of traditional method of paddy by spending less on those inputs. On the other hand, FYM (22.58 qt/ha) and human labour (15.04 mandays/ha) contributed positively whereas seed (-41.87 kg/ha), expenditure on PPC (-124.73 ml/ha) and fertilizer in N, P, K was (-6.02 kg/ha), (-3.95 kg/ha), (-1.32 kg/ha) contributed negatively. ..

Table 5.12: Decomposition of input utilization for traditional method and SRI method of paddy crop.

(Per ha.)

Sr No.	Particulars	Unit	Traditional	SRI	Difference (S-T)
1	Seeds	Kg.	48.24	6.36	-41.87
2	Human labour	Mandays	128.51	143.55	15.04
3	Nitrogen (N)	Kg.	90.13	84.10	-6.02
4	Phosphorus (P)	Kg.	34.69	30.74	-3.95
5	Potassium(K)	Kg.	5.42	4.10	-1.32
6	Farm Yard Manure (FYM)	Qt.	41.20	63.78	22.58
7	Plant Protection Chemicals (PPC)	ml	1571.52	1446.79	-124.73
8	Yield	Qt./ha			
I	Main produce		42.91	57.30	14.39
II	By produce		55.42	72.85	17.43

The decomposition analysis revealed that the per hectare yield of traditional method of paddy was less than that in SRI method. The

productivity difference between main produce in the SRI paddy and traditional paddy was estimated to be 14.39 kg/ha and by produce was 17.43 kg/ha respectively

5.5 Cobb-Douglas production function estimate for SRI and traditional methods of paddy cultivation

One of the major objectives of the study was to identify the important factors affecting production of paddy under traditional and SRI methods of paddy cultivation. For this purpose, the popularly used Cobb-Douglas production function was fitted. The production parameters of the estimated Cobb-Douglas production function are presented in Table 5.13

Table 5.13. Cobb-Douglas production function estimate for SRI and traditional methods of paddy cultivation

Particulars	SRI	Traditional
Intercept	2.841	4.569
Human labour	0.139* (0.060)	-0.194 (0.166)
Seeds	0.108* (0.064)	-0.002 (0.006)
Nitrogen (N)	0.042** (0.015)	0.040* (0.047)
Phosphorus (P)	0.005** (0.002)	-0.001 (0.005)
Farm Yard Manure (FYM)	-0.002 (0.001)	0.001* (0.002)
Plant Protection Chemicals (PPC)	0.021* (0.009)	-0.012 (0.024)
Area under crop	-0.035 (0.023)	-0.016 (0.024)
R ²	0.651*	0.115
∑b _i	0.174	0.274
Deviation from unity	0.826	0.726
F – Value	13.86	0.973
Return to scale indicate by test Of significance	Decreasing	Decreasing

Note:1) * and ** indicate significance at 5 per cent and 1 per cent levels, respectively.

2) Figure within the parenthesis are standard errors.

The coefficient of multiple determinations (R^2) was 0.115 for estimated production function of traditional method and it was 0.651 for SRI method.

The return to scale imply the behaviour of the change of total return when all the inputs are changed simultaneously in the same proportion and is indicated by the sum of the regression coefficient in our estimated Cobb-Douglas production function. Return to scale are increasing, constant or diminishing accordingly as the sum of regression coefficients is greater than, equal to, or less than unity. The sum of regression coefficient were found to 0.274 and 0.174 in case of traditional and SRI method of paddy cultivation. (Table5.13)

In order to see whether or not return to scale were constant, the sum of regression coefficient tested for their division from unity it was observed that 0.274 and 0.174 was not significantly different from unity and thus indicated decreasing return to scale in case of traditional and SRI method of paddy cultivation

In case of traditional and SRI method of paddy cultivation it was found that return to scale was decreasing. The F – value was noticed in traditional method and SRI method was 0.973 and 13.86, respectively.

In traditional method, nitrogen and FYM positively significant and seed rate, human labour, phosphorus, PPC and area was negatively significant. The elasticity coefficients in the case of SRI method indicated that the paddy output was significantly and positively influenced by all resources except FYM and area.

5.6. Coefficient of decomposition analysis between SRI and traditional methods of paddy cultivation

Using the decomposition analysis, the productivity difference between the SRI paddy and traditional paddy (yield gap) was decomposed into its constituent sources and the results are presented in Table 5.14.

Among the various sources responsible for total productivity difference. The different inputs contributing to the productivity difference between SRI method and traditional method were FYM (0.001), seed (0.007) and nitrogen (0.047) contributed positively whereas human labour (-0.074), expenditure on PPC (-0.002), phosphorus (-0.001) contributed negatively. The return to scale was - 0.088. The contribution of coefficient of (R^2) to the productivity difference between SRI and traditional methods due to was 0.291.

Table 5.14. Coefficient of decomposition analysis between SRI and traditional methods of paddy cultivation

Particulars	Coefficients	Standard Error
Intercept	0.280	
Human labour	-0.074	0.113
Seeds	0.007	0.006
Nitrogen (N)	0.047	0.030
Phosphorus (P)	0.001	0.004
Farm Yard Manure (FYM)	0.001	0.002
Plant Protection Chemicals (PPC)	-0.002	0.0167
Area under crop	-0.066	0.022
R ²	0.291*	
$\sum b_i$	-0.088	
F - Value	3.060	

Note: * indicate significance at 5 per cent levels.

5.6.1 Adoption levels and constraints in SRI method of paddy cultivation

Adoption levels of sample farmers in following suggested practices of SRI method are presented in table 5.9. Complete application of suggested practice is considered as complete adoption level and any deviation from the suggested practice is considered as partial adoption level.

Nursery area 2.5 cents for 1 ha paddy cultivation: majority 58.33 per cent of the sample farmers adopted partially nursery area and 41.67 per cent of farmers adopted it suggested nursery area.

Seed rate 5kg/ha: Among the sample farmers 33.33 percent of them applied the suggested seed rate where as the remaining 66.67 per cent of them used different levels of seed rate.

Transplanting 8-12 days aged seedlings: The sample farmers constituting 60.00 per cent to the total followed the suggested transplanting time of seedlings whereas the remaining 40.00 percent of them did not follow the suggested transplanting time.

Table 5.15 Adoption levels in SRI method of paddy cultivation

N=60

Sr. No.	Suggested Practices in SRI Method	Adoption Level	
		Complete	Partial
1	Nursery area 2.5 cents (for 1ha)	25 (41.67)	35 (58.33)
2	Seed rates 5 kg/ha	20 (33.33)	40 (66.67)
3	Transplanting 8-12 days aged seedlings	36 (60.00)	24 (40.00)
4	Careful transplanting of soil and roots	43 (71.67)	17 (28.33)
5	Wide spacing (25x25 cm ² or 30x30 cm ²)	46 (76.67)	14 (23.33)
6	Weed management	38 (63.33)	22 (36.67)
7	Water management	14 (23.33)	46 (76.67)
8	Organic manure application (10 t/ha)	17 (28.33)	43 (71.67)

(Figures in parentheses indicate percent to total number of farmers)

Careful transplanting of seedlings soil and roots intacted: majority of the sample farmers (71.67%) followed suggested transplanting method whereas, 28.33 percent of the sample farmers did not follow the suggested transplanting method.

Wider spacing (25 X 25 cm² or 30 x 30 cm²): majority of the sample farmers (81.66%) followed suggested transplanting method whereas, 18.34% of the sample farmers did not follow the suggested transplanting method.

Weed management: Of the total sample farmers 63.33 per cent of them followed the suggested weed management practice where as 36.67 per cent of the sample farmers did not practice the suggested weed management.

Water management: Nearly 76.67 per cent of the sample farmers did not follow the suggested water management practice where as 23.33 per cent of the sample farmers completely adopted the suggested water management practice.

Organic manure application (10 t/ha): Of the total sample farmers 28.33 per cent of them applied suggested organic manure where as 71.66 per cent of the sample farmers did not apply the suggested quantity of organic manure.

5.3.2 Reasons for practicing SRI method of paddy cultivation

The details reasons for practicing SRI method of paddy cultivation of selected farmers are presented in Table 5.16.

Table 5.16 Reasons for practicing SRI method of paddy cultivation

Sr. No.	Particulars	Frequency	Rank
1	Higher yield and less seed rate	60	I
2	Less water requirement	58	II
3	Less fertilizer requirement	56	III
4	Less incidence of pest and diseases	55	IV
5	Less cost	49	V

Almost the farmers growing SRI method of paddy expressed that higher yield and less seed rate was the major reason for following SRI method of paddy. So, this criterion was placed in the first rank among all the reasons for adopting the SRI method. Less water requirement was the second major reason for practicing the SRI method by the sample farmers. The saving in water was one of the major reasons which attracted the sample farmers to adopt the SRI method. Saving in fertilizer requirement was observed in SRI method of

paddy cultivation. Farmers expressed that less fertilizer requirement was one of the reason to adopt the SRI method. Majority of the sample farmers expressed that less incidence of pest and diseases was the fourth most important reason for practicing SRI method. Less cost was considerably less and sixth rank in SRI method. Less cost requirement was one of the reasons to adopt the SRI method.

5.3.3 Constraints in practicing SRI method of paddy cultivation

The details Constraints in practicing SRI method of paddy cultivation of selected farmers are presented in Table 5.17.

Table 5.17 Constraints in practicing SRI method of paddy cultivation

Sr. No.	Particulars	Frequency	Rank
1	Labour requirement is more	56	I
2	Weed manage	52	II
3	Required skilled labour	50	III
4	High rainfall	47	IV
5	Unavailability of specific implements	46	V
6	Higher seedling mortality	40	VI

High labour requirement was the major constraint in practicing SRI method. Especially during transplanting and weeding days sample farmers faced the dearth of labour availability. The SRI method was a labour intensive method of paddy cultivation. The next major constraint in SRI method was high weed infestation. Skillful labour third major constraint in SRI method. The specific constraint pertaining to the study area was poor drainage condition especially during heavy rainy seasons. The other constraints expressed by the sample farmers were manual conoweeder operation and high seedling mortality.

Chapter VI

SUMMARY AND CONCLUSIONS

Rice is one of the important food crops in the world and rank second in terms of area and production. It is the staple food for about 50 percent of the population in Asia, where 90 percent of the world's rice is grown and consumed. The world paddy production was 465.81 million tonnes in 2011-12, covering on area of 158.92 million hectare with an average yield of 4.37 tonnes per hectare. Developing countries contribution about 90 per cent of the world total rice production. In world, India, rice under area was 44.10 million ha with production 105.31 million tonnes and productivity is 3.58 tonnes/ha during the year 2011-12.

The green revolution of 1960's was oriented towards high input usage particularly hybrid seeds, fertilizers, irrigation and plant protection chemicals. As a result of higher use of these inputs the cost of cultivation escalated. This is more so in irrigated crops like paddy. The skewed distribution of green revolution results and increased costs of cultivation have given alarming signals to the future needs of food security.

SRI-System of Rice Intensification is a system of production of rice. SRI is considered to be a disembodied technological change in paddy cultivation. SRI involves the use of certain management practices, which together provide better growing conditions for rice plants, particularly in the root zone, than those for plants grown under traditional practices. This system seems to be promising to overcome the shortage of water in irrigated rice. It offers increased productivity for resources like land, labour and water. In fact, it is a less water requirement method of rice cultivation, which is suitable to poor farmers who have relatively more labour than land and capital.

Farm management deals with the organization and operation on a farm with the objective of maximizing profit from the farmers on a

continuous basis. Such study would help research workers to understand the technology adopted by the farmers and suggest new changes either in cropping pattern or in utilization so as to increase the productivity per unit of area.

The present study mainly focuses into the economic analysis of two different methods. This study would help the farmers for arranging their lands which includes more profit in crops and select such rotation which would give continuous higher income by maintaining fertility status of soil. Bankers need crop production data to fix maximum credit limits for the crop loans. This study would also be helpful to the Zillah Parishad Officer and policy makers working in this area to introduce new production technology.

In the present study an attempt has been made to carry out the "Economic annalysis of Traditional and SRI method of paddy cultivation", with a view to examine the cropping pattern, cost of cultivation, production function, decomposition analysis and constraints measures. The present study has been planned with the following objectives.

- 1) To study the socio-economic characteristic of selected farmers.
- 2) To estimate the costs and returns of paddy cultivation under SRI and traditional method of cultivation.
- 3) To identify the important factors affecting production of paddy under SRI and traditional method of cultivation.
- 4) To decompose the contribution of resources to the production differences between traditional and SRI method.
- 5) To identify important constraints in adoption of SRI method.

The study was based on the input-output data obtained from sample farmers in Bhandara and Chandrapur districts. For selection of farmers, multi-stage sampling design was employed. In this procedure,

at first stage, two major paddy growing districts following both traditional and SRI method of rice cultivation were purposively selected. From each district, two major paddy growing Talukas following both the methods of rice cultivation were selected at second stage. Then at third stage, three major paddy growing villages following traditional and SRI methods of rice cultivation were selected from each Talukas. In the final stage, ten farmers were randomly selected from each village comprising five farmers for SRI method and five farmers for traditional method of rice cultivation. Thus, the total sample size was 120. The necessary primary data will be obtained from the sample farmer through personal interview with the help of pre-tested and well structured schedule. The data was collected certainly to the Kharif season of the agriculture year 2012-13.

For evaluating the specific objectives of the study, necessary primary data were obtained from the sample farmers through personal interview with the help of pre-tested and well-structured schedule. The data so collected pertained to the kharif season of the agricultural year 2012-13. The data relating to general information about the sample farmers, their assets position, cropping pattern, details on various inputs used in paddy cultivation like chemical fertilizers, plant protection chemicals, seed materials and labour and cultivation practices such as land preparation, transplanting, irrigation, interculture and harvesting along with labour requirement were collected. The adoption levels of the recommended methods of SRI method of paddy cultivation, its advantages and the constraints for it were also elicited.

For the purpose of achieving the objective of the study .The collected data are subjected to the statistical analysis for this purpose, tabular and production function analysis was employed.

The result of study is summarized as follows.

Traditional paddy farmers and SRI paddy farmers are found to be of middle age group. The average education of traditional paddy

farmers and SRI paddy farmers was secondary school. The average family size of traditional paddy farmers and SRI paddy farmers was medium. The average family income of traditional paddy farmers and SRI paddy farmers was medium.

The average land holding of traditional paddy farmers and SRI paddy farmers was 1.66 hectares and 1.23 hectares, respectively. SRI paddy farmers were growing more number of crops per season and per year than the traditional paddy farmers. The intensity of cropping was worked out 125.97 per cent in traditional method. The intensity of cropping is higher on SRI method 182.02 per cent because of more intensive use of land. The cropping pattern was dominated by paddy crop in kharif season where as in rabi season, it was dominated by lakhori crop in both method.

Nursery cost for traditional method (Rs. 1901.67) was considerably higher than that of the SRI method (Rs. 645.82). The share of seed was around 62.83 per cent contributing largely to the higher total nursery cost in traditional method. In SRI method also the expenditure on seeds accounted to a share (26.96 per cent). The share of fertilizer was negligible in both the methods. In the SRI method the share of PPC in total nursery cost was 4.61 per cent and 9.95 per cent in traditional method. The expenditure made on labour (Rs. 431.62) in traditional nursery management was higher than those in SRI nursery management Rs.388.88, respectively.

The quantities of seed, fertilizer, bullock power, machine labour and PPC use was more in traditional paddy cultivation whereas human labour and FYM use was more in SRI paddy cultivation.

The Irrigation charges, land revenue, depreciation and interest on fixed capital were found to be more for traditional paddy farmers, whereas interest on working capital, repairs, incidental and rental value of land was found to be more for SRI paddy farmers.

The share of human labour in the total cost was more in both the methods. The least contributing item to the total cost was incidental and land revenue in both the methods. The share of cost A in total cost was 65.57 per cent and 58.97 per cent in traditional paddy and SRI paddy, respectively.

The rental value of land was the major contributing expenditure to the fixed cost in both the methods. The share of cost B in total cost was 92.12 per cent and 91.61 per cent in traditional paddy and SRI paddy, respectively.

Per hectare cost of cultivation of traditional method farmers at cost 'A', cost 'B' and cost 'C' were Rs. 30601.03, Rs. 42992.66 and Rs. 46671.10 respectively. The per hectare cost of cultivation SRI method farmers at cost 'A', cost 'B' and cost 'C' were Rs. 32039.94, Rs. 49771.76 and Rs. 54330.85 respectively.

SRI method paddy farmers harvested higher yields of main produce was (57.30 qtl/ha) than the traditional method paddy farmers (42.91 qtl/ha). However the yields of by produce was (72.82 qtl/ha) in SRI method and (55.42 qtl/ha) in traditional method.

Net returns over cost A, cost B and cost C in SRI method paddy cultivation were more than those of the traditional method paddy cultivation.

The per quintal cost of production was Rs. 1057.48 for traditional method and Rs. 914.55 for SRI method. The return per rupee spent was around Rs 1.92 for SRI paddy method and Rs. 1.55 for traditional paddy method.

The different inputs contributing to the productivity difference between SRI method and traditional method. This implied that farmers growing SRI method paddy obtained higher output per hectare than that obtained by the farmers of traditional method of paddy by spending less on those inputs. On the other hand, FYM (22.58%) and human

labour (15.04%) contributed positively whereas seed (-41.87%), expenditure on PPC (-124.73%) and fertilizer in N, P, K was (-6.02%), (-3.95%), (-1.32%) contributed negatively.

The decomposition analysis revealed that the per hectare yield of traditional method of paddy was less than that in SRI method. The productivity difference between main produce in the SRI paddy and traditional paddy was estimated to be 14.39 per cent and by produce was 17.43 per cent respectively.

The coefficient of multiple determinations (R^2) was 0.115 for Cobb-Douglas production function of traditional method and it was 0.651 for SRI method. The sum of regression coefficient was found to 0.274 and 0.174 in case of traditional and SRI method of paddy cultivation. However, decreasing returns to scale were noticed in both traditional paddy and SRI paddy production.

In traditional method, nitrogen and FYM positively significant and seed rate, human labour, phosphorus, PPC and area was negatively significant. The elasticity coefficients in the case of SRI method indicated that the paddy output was significantly and positively influenced by all resources except FYM and area.

The different inputs contributing to the productivity difference between SRI method and traditional method were FYM (0.001), seed (0.007) and nitrogen (0.047) contributed positively whereas human labour (-0.074), expenditure on PPC (-0.002), phosphorus (-0.001) contributed negatively. The contribution of coefficient of (R^2) to the productivity difference between SRI method and traditional method due to was 0.291.

Complete adoption level was high in the case of wider spacing (81.66 per cent) farmers followed by careful transplanting of soil and roots intact seedlings practice (81.66 per cent) farmers, weed management (63.33 per cent) farmers and transplanting time (60.00 per cent) farmers. Partial adoption level was high in the case of water

management (76.67 per cent) farmers followed by organic manure application (71.66 per cent) farmers and seed rate (66.67 per cent) farmers.

Major reasons for practicing SRI method by sample farmers were higher yield levels and less seed rate. Major constraints in practicing SRI method were labour requirement is more, weed menace and required skilled labour.

Conclusions:

From the present study the following conclusion are drawn:-

1. The average age of selected farmers was 44 year in traditional and SRI methods. The average education was 8th standard in traditional and SRI method. In the type of family about 92 to 95 per cent farmers in nuclear family in both methods. Whereas in joint family the 8.34 per cent farmers in traditional method and 5.00 per cent farmer in SRI method. In the traditional method average family income was Rs.37,350 and SRI method was Rs.38,467.
2. The average size of holding was 1.66 hectares in traditional method and 1.23 hectares in SRI method. The intensity of cropping was worked out 125.97 per cent in traditional method and 182.02 per cent in SRI method. In kharif season the cropping pattern was dominated by paddy crop where as in rabi season, it was dominated by lakhori crop in traditional method and SRI method.
3. The major expenditure item of nursery cost was expenditure made on seeds in traditional paddy (Rs. 1194.79) and SRI paddy (Rs. 174.11). The expenditure made on PPC (Rs. 189.16) and labour (Rs. 431.62) in traditional nursery management was higher than those in SRI nursery management (Rs.29.79 and Rs.388.88, respectively). In the traditional method, the share of fertilizer in total nursery cost was lowest 4.52 per cent and 8.21 per cent in SRI method, respectively.

4. Per hectare cost of cultivation of traditional method farmers at cost 'A', cost 'B' and cost 'C' were Rs. 30601.03, Rs. 42992.66 and Rs. 46671.10 respectively. The per hectare cost of cultivation SRI method farmers at cost 'A', cost 'B' and cost 'C' were Rs. 32039.94, Rs. 49771.76 and Rs. 54330.85 respectively. The Per quintal Cost of production of traditional method paddy growers was Rs. 1057.48. It was higher in SRI method paddy growers i.e. Rs. 914.55. The highest net return obtained from the SRI method i.e. Rs 49771.76 followed by traditional method i.e. Rs. 25546.45. The return per rupee spent was around Rs. 1.92 for SRI paddy method and Rs. 1.55 for traditional paddy method.

5. The productivity difference between yield of main produce in the SRI paddy and traditional paddy was estimated to be 14.39 kg and yield of by produce was 17.43 kg respectively. The sum of regression coefficient was found to 0.274 and 0.174 in case of traditional and SRI method of paddy cultivation. However, decreasing returns to scale were noticed in both traditional paddy and SRI paddy production.

6. Complete adoption level was high in the case of wider spacing (81.66 per cent) farmers followed by careful transplanting of soil and roots intact seedlings practice (81.66 per cent) farmers, weed management (63.33 per cent) farmers and transplanting time (60.00 per cent) farmers. Partial adoption level was high in the case of water management (76.67 per cent) farmers followed by organic manure application (71.66 per cent) farmers and seed rate (66.67 per cent) farmers. Major reasons for practicing SRI method by sample farmers were higher yield levels and less seed rate. Major constraints in practicing SRI method were labour requirement is more, weed menace and required skilled labour.

Chapter VII

LITERATURE CITED

- Alshi, M. R. 1981. Impact of technological change on production employment and factor shares in cotton in Akola district (Maharashtra). Ph. D. Dissertation submitted to Indian Agricultural Research Institute, New Delhi.
- Anbarassan, A., V.Karthick, B.Swaminathan and T. Arivelarasan,2013. System of Rice Intensification (SRI) and its implications over food security and farmer sovereignty. Ph.D scholars, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore.
- Anonymous, 2006. Agriculture Output, Economic Intelligence Service, March 2006, pp. 50-57.
- Anonymous^a, 2012. Directorate of Agriculture Economics and Statistics, Department of Agriculture and Co-operation Government of India.
- Anonymous^b, 2012. United States Department of Agriculture, Foreign Agriculture Service.
- Anthofer, J. 2004. The potential of the System of Rice Intensification (SRI) for poverty reduction in Cambodia. <http://www.tropentag.di/2004/abstracts/full/399.pdf>.
- Aziz, M. B. and R.Hassan, 2000. Evaluation of System of Rice intensification (SRI) in Bangladesh. Report for the Locally – Intensified Farming Enterprises (LIFE) Project, CARE-Bangladesh, Dhaka.
- Badal, P. S. and R. P. Singh, 2001. Technological change in maize production: A case study of Bihar. Indian Journal of Agricultural Economics, 56(2): 211-219.
- Barah B.C. (2009). Economic and Ecological benefits of system of rice intencification (SRI) in Tamil Nadu.Agricultural Economics Research Review, 22: 209-214.
- Barah, B.C. and S. Pandey, 2005. Rainfed rice production systems in Eastern India: An on farm diagnosis and policy alternatives. Indian Journal of Agricultural Economics, 60(1): 110-136.

- Barret, C. B., C. M. Moser, O. Mhugh, and J. Bavison, 2003. Better technology, better plots or better farmers and quest: Identifying changes in productivity and risk among Malagasy rice farmers. *American Journal of Agricultural Economics*, 86(4): 869-888.
- Basavaraja H., S.B. Mahajanashetti and P.Shivanagaraju.(2008). Technological change in paddy production: A comparative analysis of traditional and SRI method of cultivation' *Indian Journal of Agril. Economics*, 63(4):.629-640.
- Bibhas Kanti De, 2010. Employment and Income Generation in Paddy Cultivation through Sri in Tripura. *Journal of Community Mobilization and Sustainable Development* Vol. 5(2), 087-091, July-December, 2010.
- Bisaliah, S. 1977, decomposition analysis of output change under new production technology in wheat farming: Some implications to returns on investment. *Indian Journal of Agricultural Economics*, 32(3): 193-201.
- Bonlieu, F., 1999. performances du systeme de riziculture intensive dans la region du Menabe a Madagascar : Evaluations des possibilites de developement. Memoire de fin detude. Angers, France, Ecole Superieur d' Agriculture d' Angers.
- Cassman, K. G., ENG, S, D. C. OLK, J. K. Ladha, W. Reichardt, A. Doberman and U. Singh, 1998. Opportunities for increased nitrogen-use efficiency from improved resource management in irrigated Rice systems. *Field Crops Research*, 56: 7-39.
- Chandrashekar, S., Vaster., K.C. Lalitha, M.T. Lakshmi Narayana, and A.D. Ranganatha, 2001. Production constraints faced by potato growers. *Rural India*, 64 (2-3): 33-34.
- Chitnis, D.H. and M.G. Bhikgaonkar, 1987. Constraints causing technological gap in dry farming systems. *Journal of Maharashtra Agricultural Universities*, 12 (1): 84-88.
- Chowdary, K. R., G. V. Krishnarao, and N. Vasudeva, 1993. Yield gaps in groundnut crop – A case study of Ananthpur district in Andhra Pradesh. *Indian Journal of Agricultural Economics*, 48 (3): 381-382.
- Devi Sita K. and T. Ponnarasi 2009. An Economic analysis of modern rice production technology and its adoption behavior in Tamil Nadu. *Agricultural Economics Research Review*, 22: 341-347.

- Gaddi, G. M., S. M. Mundinamani, and S. A. Patil, 2002. Yield gaps, constraints and potential in cotton production in North Karnataka – An econometric analysis. *Indian Journal of Agricultural Economics*, 57(4): 722-734.
- Gavisiddappa, D., Balachandra Naik, G.K. Hiremath, and S.M. Mundinamani, 2001. Problems in Gherkin production and trade in Haveri district of Karnataka. *Rural India*, 64(9):184-186.
- Gundarao, D. S., S. Bisaliah, and H. S. Krishanaswamy, 1985. Technical change and efficiency gain in dry land agriculture: An economic study. *Margin NCAER*, pp. 37-38.
- Gupta, D. D., A. Rathi, and K. K. Shama, 1985. Economics of paddy cultivation in Haryana. *Agriculture Situation in India*, 42: 1051-1058.
- Halder Surjit, Honnaiah and G.Govindaraj, 2012. System of Rice Intensification (SRI) method of rice cultivation in West Bengal (India): An Economic analysis. Paper prepared for presentation at the International Association Of Agricultural Economics (IAAE) Triennial conference, Foz do Iquacu, Brazil, 18-24 August, 2012.
- Hirala Jana and H.K. Verma, 2004. Constraints faced by the growers in the adoption of recommended plant protection practices. *Rural India*, 67 (6-7): 122.
- Hirsch, R., 2000. La riziculture malgache revisitee: Diagnostic et perspectives (1993-1999). Antananarivo, Agence Francaise de Development.
- Jeen T. Shrinivasan, 2012. An economic analysis of paddy cultivation in the kole land of Kerala. *Indian Journal Of Agricultural Economics* 67(2): April-June 2012, 213-224.
- Joelibarison, 1998. Perspective de developement de la region de Ranomafana : Les mecanismes physiologiques du riz sur de bas-fonds: cas du SRI. Memoire de fin d' etudes. Antananarivo : Ecole Superieure des Sciences Agronomiques, University of Antananarivo.
- Kaul Sushila, Ghasi Ram and Sanjeev Pawar, 2009. Economics analysis of productivity and profitability in Rice production in India. *Agril situation in India*.pp-3.
- Kiresur V., R.Balakrishnanand M.V.R Prasad (1996). A model for estimation of economic sustainability of improved oilseed crop production technologies. *Indian Journal of Agril. Economics*, 51:358-341.

- Kumar D. and Y. S. Shivay, 2004. System of Rice Intensification. *Indian Farming*, 54(8): 18-22.
- Laguna, R. J. P. 2002. Rice intensification with less inputs. *Phil Rice Newsletter*, 15(4): 12.
- Mohandas, K. and E. K. Thomas, 1997. Economic analysis of rice production in Kuttand area of Kerala. *Agriculture Situation in India*, 54: 555-560.
- Narasimham, S., V. T. Raju, and S. M. Shareef, 2003. Cost and returns of paddy in Yanam Region of Union Territory of Pondicherry. *The Andhra Agricultural Journal*, 50(1): 131-135.
- Nasurudeen, P. and N. Mahesh, 2004. Impact of technology on paddy farms in Karaikal region of Union territory of Pondicherry. *Agricultural Economics Research Review*, 17 (conference No.): 43-50.
- Nemoto, K., S. Morita, and T. Baba, 1995. Shoot and root development in Rice related to the phyllochron. *Crop Science*, 3: 24-29.
- Palanisami, K and K R Karunakaran (2012). "Adoption Levels of SRI in Different Regions of India", Draft report, IWMI-Tata Policy Programme, International Water Management Institute, Hyderabad.
- Palanisami, K., K. R. Karunakaran, Upali Amarasinghe and C. R. Ranganathan (2013). Doing Different Things or Doing It Differently? Rice Intensification Practices in 13 States of India. *Economic & Political Weekly* February 23, 2013 vol. XLVIII no. 8
- Parayil Chitra, A. D. V. Samuel, T. Alagumani, B. Shanmugassundaram and S. Menka, (2009). SRI cultivation in Kerala: A comparative economic analysis in Palakkad District. *Agricultural Economics Research Review*, 22:496.
- Patil, S. M., L. B. Kunnal, and N. N. Karnool, 1997. Yield gap analysis in groundnut production. *Karnataka Journal of Agricultural Sciences*, 10: 790-796.
- Pouchepparadjoyu, A., P. Kumaravelu, and Lalith Achoth, 2005. An econometric analysis of green technology adoption in irrigated rice in Pondicherry Union Territory. *Indian Journal of Agricultural Economics*, 60(4): 660-675.
- Radha, Y. and K. R. Chowdry, 2005. Comparative economics of seed production vis-à-vis commercial production of cotton in Andhra Pradesh. *Indian Journal of Agricultural Economics*, 60 (1): 94-102.

- Rajendra, U. 2005. Performance of SRI in Nepal. *LEISA*, India, 7(2) : 20-21
- Ramasamy, S., H. F. M. Ten Berge, and S. Purushothaman, 1997. Yield formation in rice response to drainage and nitrogen application. *Field Crops Research*, 51: 65-82.
- Rangaswamy, A., R. Venkatswamy, M. Premshekhkar, C. Jayanthi, and S.P. Palaniappan, 1992. Integrated farming systems for rice based ecosystem. *Madras Agricultural Journal*, 82(4): 290-293.
- Rangaswamy, R. 1986. Rapporteur's report on science and technology for dry land farming. *Indian Journal of Agricultural Economics*, 41 (3): 413-417.
- Rao R. I.V.Y. (2011). Estimation of efficiency, sustainability and constraints in SRI vis-à-vis traditional methods of paddy cultivation in North Coastal Zone of Andhra Pradesh. *Agricultural Economic Research Review*, 24: 325-331.
- Reddy, V. R., P. P. Reddy, M. S. Reddy, and D. S. R. Raju, 2005. Water use efficiency: A study of System of Rice Intensification (SRI) adoption in Andhra Pradesh. *Indian Journal of Agricultural Economics*, 60(3): 458-472.
- Rekha, S. 2004. Fostering growth on a diet of Njavava Rice, 25th September, www.Indiainfoline.com.
- Sarup, S. and R. K. Pandey, 1981. Assessment of regional variations in yield gap of wheat crop in India. *Agriculture Situation in India*, 36: 625-627.
- Shah, J.P. and S.B. Kute, 1987. Infrastructural constraints and strategies for promoting fertilizer uses in rainfed areas. *Fertilizer News*, 32(8): 27-30.
- Shanmugasundaram B. and Chitra Parayil, 2012. System of rice intensification vis-à-vis traditional method of paddy cultivation in central zone of Kerala under Farmer Participatory Action Research Programme (FPARP) Indian Water Week.
- Sivanagaraju, P. 2006. Traditional and SRI methods of paddy cultivation – A comparative economic analysis. M. Sc. (Agri.) Published Thesis, University of Agricultural Sciences, Dharwad.
- Stoop, A. W., N. Uphoff and A. Kassam, 2002. A review of agricultural research issues raised by the system of Rice Intensification (SRI) from Madagascar: Opportunities for improving farming systems for resource poor farmers. *Agricultural Systems*, 71(3): 249-274.

- Tamizheniyar, S., K. B. Umesh, and V. V. Krishna, 2003. Integrated pest management in rice production in Tamil Nadu: A resource Economic Analysis, *Agricultural Economics Research Review*, 16: 67-74.
- Thakur, D.S. and K.D. Sharma, 1984. Weakling of Agriculture in Himachal Pradesh- An introduction, *Himachal Journal of Agricultural Research*, 10(2): 1-11.
- Thakur, J. and D. K. Sinha, 1994. An empirical analysis of technological and functional income distribution in rice production in Bihar agriculture. *Agricultural Economics Research Review*, 7: 47-55.
- Thiruvengkatachari, K., B. N. Vishwanathan, and K. S Seetharam, 1991. An economic analysis of groundnut production in rainfed area – A case study in Tamil Nadu. *Agriculture Situation in India*, 46: 431-438.
- Uphoff, N. and E. Fernandes, 2002. System of rice intensification gains momentum. *LEISA India*, 4(3): 22-27.
- Vivekananda, 1999. Problems and prospects of agricultural development in Karnataka. Occasional Paper-9, NABARD, Mumbai.
- Weijabhandara, D.M.D.I., G.S. Dasog, P.L. Patil and Manjunath Hebbar, 2011. Effect of Nutrient Levels on Rice (*Oryza sativa* L.) under System of Rice Intensification (SRI) and Traditional Methods of Cultivation. *Journal of the Indian Society of Soil Science*, Vol. 59(1): 67-73.
- Yang, S. K. and S. Suon, 2004. An assessment of ecological system of rice intensification (SRI) in Cambodia in wet season 2002. CEDAC Field Document, January 2004.

VITA

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3	SSC	2004	First	Pune Board	General

6. **Field of Interest** : Agriculture.



Place : Nagpur

(Thorat Rushikesh Shashikant)

Date : 31/09/2013

APPENDIX

ECONOMIC ANALYSIS OF TRADITIONAL AND SRI METHOD OF PADDY CULTIVATION

College of Agriculture, Nagpur
M.Sc (Agri.) Research Work

1) Socio-economic status of Paddy grower:-

1. Name :
2. Age in Years :
3. Education (year of school) :
4. Village :
Tahsil : District: - Chandrapur/Bhandara
5. Occupation : Main occupation
: Sub occupation

2. Information of Land (ha)

Sr.No.	Information of Land (ha.)	Own land	Leased in	Leased out
1	Total land holding			
2	Fallow land			
	a) Permanent fallow			
	b) Current fallow			
3	Net cultivable area			
4	Area sown more than once			
5	Irrigated land			
6	Gross cropped area			
7	Source of irrigation			
8	Land Price (Rs. / ha.)			

3) Information of member of family:-

Type of family (Join/ nuclear):-

Sr. No	Name	Sex (M/F)	Age (yrs.)	Education	Occupation		Income (Rs.)
					Main	Sub	
1							
2							
3							
4							
5							
	Total						

4) Cropping Pattern 2011-12 (ha):-

Sr. No.	Crop Variety	Area under crop	Production	Quintal sold	Price/qtl (Rs.)
A	Kharif				
1					
2					
3					
4					
	Total				
B	Rabi				
1					
2					
3					
4					
	Total				
C	Summer				
1					
2					
D	Perennial				
1					
2					
	Total				
II	Horticulture crops				
1					
2					
	Total				
E	Kharif 2012-13				
	Grand Total				

5) Information of Livestock:

Sr. No.	Particular	No./Qty.	Purchased Year	Present value(Rs.)
1	Bullock			
2	Cow			
3	Buffalo			
4	Goat			
5	other			
	Total			

6) Inventory on implements and machinery for the year 2012-13:-

Sr. No.	Assets	No./Qty.	Purchased Year	Present Price(Rs.)
1	Tractor			
2	Thresher			
3	Oil Engine			
	Total			

7) Commonly used assets:-

(Price in Rs.)

Sr. No.	Assets	No./Qty	Purchased Year	Present Price	Present Total Value
1	Iron Plough				
2	Harrow				
3	Bullock Cart				
4	Hoe				
5	Seed Drill				
6	Sprayer				
	a) Hand sprayer				
	b) foot sprayer				
	c) power sprayer				
7	Others				
	Total				

8) Irrigation structure:-

Sr. No.	Assets	No./Qty.	Purchased Year	Present Price(Rs.)
1	Well			
2	Electric Pump			
3	Shed for elec. pump			
4	Pipe line (length)			
5	Drip Irrigation System			
6	Electricity bill			
	Total			

9) Information about building and assets:

Sr. No.	Particulars	Type of Building			Current Value (Rs.)
		Year	Brick	Kaccha	
1	Residential				
2	Farm building				
3	Animal shed				
4	Implement shed				
5	Machinery				
6	Implements				

VI. Adoption level of SRI method of paddy cultivation by farmers:

Sl.No	Suggested SRI method of practices	100%	Partial	0%
1	Nursery area 1 cent (for 1 acre of land)			
2.	Seed rate 2 kg / acre			
3.	Transplanting 8-12 days seedlings			
4.	Careful transplanting of soil and roots intacted Seedlings			
5.	Planting at wider spacing per say 25x25 cm ² or 30x 30 cm ²			
6.	Weed management (Working with rotary weeder initially at 10-12 days after transplanting and there after thrice at 10 days interval)			
7.	Water management (Field should kept wet and water should not be allowed to stagnate)			
8.	Organic manure application (10 t / ha)			
9.	Others			

VII. Reasons for practicing SRI method:

Sl. No.	Particulars	Yes
1.	Suitability of land	
2.	Less seed rate	
3.	Less water requirement	
4.	Less fertilizer requirement	
5.	Less incidence of pest and diseases	
6.	Less number of days to transplant seedlings	
7.	Hybrid responsive	
8.	Higher yield	
9.	Less cost	
10.	Others	

VII. Constraints for SRI method

Sl.NO.	Particulars	Yes
1.	More Labour requirement	
2.	Weed menace	
3.	Unavailability of implements	
4.	Cyclone / Flood	
5.	Higher seedling mortality	
6.	Others	

