

**RESOURCE INTENSIVE AGRICULTURE AND
SUSTAINABILITY – AN ECONOMIC STUDY OF GINGER
CULTIVATION IN MYSORE DISTRICT**

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PALB 1100

**DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF AGRICULTURAL SCIENCES, GKVK,
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**RESOURCE INTENSIVE AGRICULTURE AND
SUSTAINABILITY – AN ECONOMIC STUDY OF GINGER
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Thesis submitted to the

University of Agricultural Sciences, Bangalore

In partial fulfillment of the requirements

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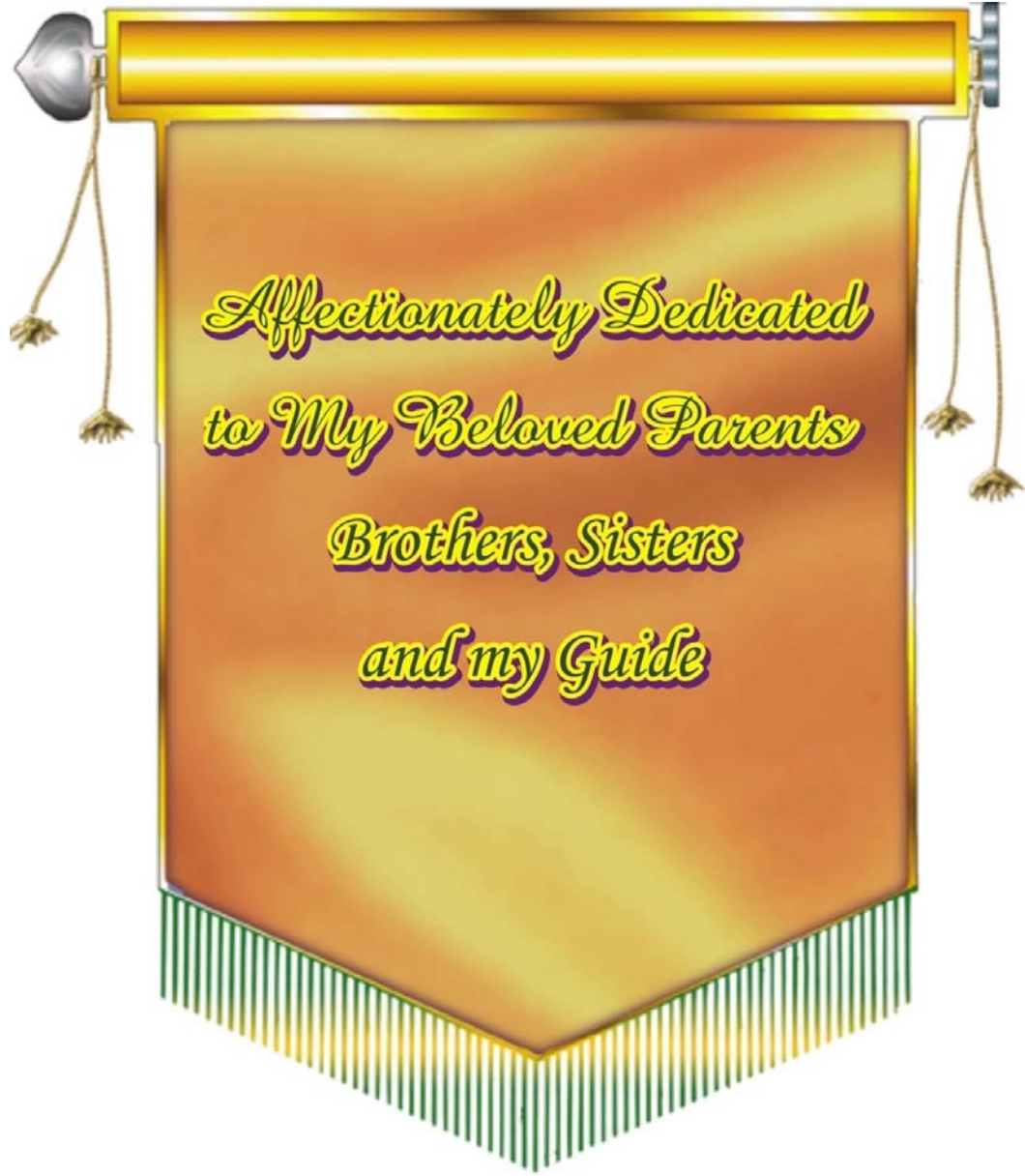
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in

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*Affectionately Dedicated
to My Beloved Parents
Brothers, Sisters
and my Guide*

**DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF AGRICULTURAL SCIENCES
BANGALORE – 560 065**

CERTIFICATE

This is to certify that the thesis entitled “RESOURCE INTENSIVE AGRICULTURE AND SUSTAINABILITY – AN ECONOMIC STUDY OF GINGER CULTIVATION IN MYSORE DISTRICT” submitted by Mr. NAVANEETHA. V, ID NO. PALB 1100 for the award of the degree of MASTER OF SCIENCE (AGRICULTURE) in AGRICULTURAL ECONOMICS to the University of Agricultural Sciences, Bengaluru, is a record of bonafide research work carried out by him during the period of his study in this University under my guidance and supervision and thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

**BENGALURU
JULY 2013**

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It's my heart's turn....

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**RESOURCE INTENSIVE AGRICULTURE AND SUSTAINABILITY – AN
ECONOMIC STUDY OF GINGER CULTIVATION IN MYSORE DISTRICT**

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Abstract

Dr. B. Chinnappa,

Major Advisor

Ginger is one of the earliest known oriental spices and is being cultivated in India for both as fresh vegetable and as a dried spice, since time immemorial. Present study was undertaken to examine the land use and lease pattern in ginger cultivation. Primary data was collected from 40 Owner cultivated and 40 leased-in cultivated ginger farmers in Mysore district. Costs and returns concept and Cobb-Douglas analysis, were employed to analyze the Comparative economics and resource use efficiency. Sustainability of ginger cultivation was assessed by using sustainability index. Constraints in ginger cultivation were documented and analysed using Garrett's ranking technique.

In the study area majority of the farmers who leased out lands were marginal farmers (75 %) and those who have leased-in lands were large farmers (47.24 %). Leased-in ginger farmers incurred relatively higher cost of cultivation per acre (Rs.1,81,630) compared with owner cultivated ginger farmers (Rs.1,55,547). However, net returns per acre realized with also higher with leased-in farms (Rs. 1,27,838) compared with owner cultivated farms (Rs. 1,07,209) per acre. Input use intensity reveals that leased-in farmers were found to use fertilizer more than the recommended dosage (173 %) compared to owner cultivated ginger farmers (122.5 %). Sustainability analysis indicated that ginger cultivation was unsustainable as indicated by the indices. High incidence of disease, high rhizome cost, non availability of varieties, low quality rhizome, high input cost and low yields were major constraints expressed by ginger farmers.

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Major Advisor

ಶುಂಠಿಯ ಸಂಪನ್ಮೂಲ ತೀವ್ರ ಕೃಷಿ ಮತ್ತು ಸಂರಕ್ಷಣೆ - ಮೈಸೂರು ಜಿಲ್ಲೆಯಲ್ಲಿನ ಒಂದು
ಆರ್ಥಿಕ ಅಧ್ಯಯನ.

ನವನೀತ . ವಿ

ಪ್ರಬಂಧದ ಸಾರಾಂಶ

ಶುಂಠಿಯು ಪುರಾತನ ಕಾಲದಿಂದಲೂ ಬೆಳೆಯುತ್ತಿರುವ ಒಂದು ಮಸಾಲೆ ಸಾಂಬಾರು ಪದಾರ್ಥವಾಗಿದ್ದು, ಇದನ್ನು ತಾಜಾ ತರಕಾರಿಯಾಗಿಯೂ ಮತ್ತು ಒಣಗಿದ ಮಸಾಲೆಯಾಗಿಯೂ ಬಳಸುತ್ತಾರೆ. ಪ್ರಸ್ತುತ ಅಧ್ಯಯನವನ್ನು ಶುಂಠಿ ಕೃಷಿಯಲ್ಲಿ ಭೂಬಳಕೆ ಮತ್ತು ಗುತ್ತಿಗೆ ಮಾದರಿಯನ್ನು ಪರಿಶೀಲಿಸಲು ತೆಗೆದುಕೊಳ್ಳಲಾಗಿತ್ತು. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಪ್ರಾಥಮಿಕ ಮಾಹಿತಿಯನ್ನು ಗುತ್ತಿಗೆ ಕೃಷಿ ಮತ್ತು ಮಾಲೀಕ ಕೃಷಿ ಮಾದರಿಯಲ್ಲಿ ಶುಂಠಿ ಬೆಳೆಯುತ್ತಿರುವ ಮೈಸೂರಿನ ಲಂ ರೈತರಿಂದ ಸಂಗ್ರಹಿಸಲಾಗಿತ್ತು. ಆದಾಯ ಮತ್ತು ವೆಚ್ಚ, ನಿವರ್ಥನ ವಿಶ್ಲೇಷಣೆಯನ್ನು, ತುಲನಾತ್ಮಕ ಆರ್ಥಿಕತೆ ಹಾಗೂ ಸಂಪನ್ಮೂಲ ಸಾಮರ್ಥ್ಯವನ್ನು ವಿಶ್ಲೇಷಿಸಲು ಬಳಸಲಾಗಿದೆ. ಇದರಲ್ಲಿ ಮಾಲೀಕರ ಸಂರಕ್ಷಣೆ ಶುಂಠಿ ಕೃಷಿ ಮತ್ತು ಗುತ್ತಿಗೆ ಶುಂಠಿ ಕೃಷಿಯನ್ನು ಸಮರ್ಥನೀಯತೆಯ ಸೂಚ್ಯಂಕವನ್ನು ಬಳಸಿಕೊಂಡು ಅಂದಾಜು ಮಾಡಲಾಗಿರುತ್ತದೆ. ಗ್ಯಾರಂಟಿ ಶ್ರೇಣಿಯನ್ನು ಬಳಸಿಕೊಂಡು ಶುಂಠಿ ಕೃಷಿಯ ತೊಂದರೆಗಳನ್ನು ವಿಶ್ಲೇಷಿಸಲಾಗಿದೆ.

ಶುಂಠಿ ಕೃಷಿಯಲ್ಲಿ ಗುತ್ತಿಗೆ ತೆಗೆದುಕೊಂಡವರ ಪೈಕಿ ಬಹುತೇಕರು ಕನಿಷ್ಠ ರೈತರ ವರ್ಗಕ್ಕೆ ಸೇರಿದ್ದು (ಶೇಕಡಾ ೭೫), ಅದರಂತೆ ಗುತ್ತಿಗೆ ಕೊಟ್ಟವರ ಪೈಕಿ ದೊಡ್ಡ ರೈತರ ವರ್ಗಕ್ಕೆ ಸೇರಿರುತ್ತಾರೆ (ಶೇಕಡಾ ೪೭.೨೪). ಶುಂಠಿ ಕೃಷಿಯಲ್ಲಿ ಗುತ್ತಿಗೆ ಮಾದರಿಯ ರೈತರು, ಮಾಲೀಕ ಮಾದರಿಯ ರೈತರಿಗೆ ಹೋಲಿಸಿದರೆ ಪ್ರತಿ ಎಕರೆಗೆ ಅತೀ ವೆಚ್ಚವನ್ನು (ರೂ. ೧೮,೬೩೦) ಭರಿಸಿದ್ದು ಕಂಡು ಬಂದಿದೆ. ಆದರೂ, ನಿವ್ವಳ ಆದಾಯವು ಪ್ರತಿ ಎಕರೆಗೆ ಮಾಲೀಕ ಮಾದರಿಯ ಶುಂಠಿ ಕೃಷಿಯಲ್ಲಿ ಅಧಿಕವಾಗಿರುವುದು ಕಂಡು ಬಂದಿದೆ. ಗುತ್ತಿಗೆ ಮಾದರಿಯ ರೈತರು ರಸಗೊಬ್ಬರವನ್ನು ಶಿಫಾರಸ್ಸು ಮಾಡಿದ ಪ್ರಮಾಣಕಿಂತ ಅಧಿಕವಾಗಿ ಬಳಸುತ್ತಾರೆ (ಶೇಕಡಾ ೧೭೩). ಸಂರಕ್ಷಣೆ ವಿಶ್ಲೇಷಣೆಯ ಸೂಚ್ಯಂಕದ ಪ್ರಕಾರ ಶುಂಠಿ ಕೃಷಿಯು ಅಸಂರಕ್ಷಣೆ ಎಂದು ಸೂಚಿಸಿದೆ. ರೋಗದ ತೀವ್ರತೆ, ಹೆಚ್ಚಿನ ಬೇರುಕಾಂಡ ವೆಚ್ಚ, ಆಧುನಿಕ ತಳಿಗಳ ಲಭ್ಯತೆ, ಕಡಿಮೆ ಗುಣಮಟ್ಟದ ಬೀಜ ವಸ್ತು ಮತ್ತು ಕಡಿಮೆ ಇಳುವರಿಯ ಶುಂಠಿ ಉಳುಮೆ ರೈತರು ಎದುರಿಸುವ ಪ್ರಮುಖ ನಿರ್ಬಂಧಗಳನ್ನು ಹೊಂದಿರುತ್ತಾರೆ.

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(ಡಾ. ಬಿ. ಚಿನ್ನಪ್ಪ)

ಪ್ರಮುಖ ಸಲಹೆಗಾರ

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I. INTRODUCTION

Ginger, the rhizome or the underground modified stem of the plant '*Zingiber Officinale Roscoe*' of 'Zingiberaceae' family, is an important commercial spice crop grown since ancient times in India. It is one of the earliest oriental spices known to Europe and is still in large demand. In U.S.A., Canada, U.K. and other western countries, ginger is widely used in baking, meat processing and soft drink manufacturing industries besides cooking. Ginger, preserved in brine is most popular in Japan. Drinking ginger coffee is a deep rooted social custom in many West Asian countries. Apart from the encouraging prospects of ginger demand, the demand for its products like ginger oil and oleoresin is building up day by day.

It is one of the earliest known oriental spices and is being cultivated in India for both as fresh vegetable and as a dried spice, since time immemorial. Ginger is obtained from the rhizomes of *Zingiber officinale*. The ginger family is a tropical group, especially abundant in Indo-Malaysian region, consisting of more than 1200 plant species in 53 genera. The area under ginger cultivation in India is 107.54 thousand hectare with a total production of the country is 385.33 thousand tonnes. (FAO 2013)

A Brief History of Ginger

Ginger has been used as a spice and medicine in India and China since ancient times. Its place of origin has not been established with conformity but Indo-China region is supposed to be the home of this unique spice. Excavations in the Indus Valley reveal that herbs and spices had been used even before about 1000 B.C. Various spices such as cardamom, ginger, black pepper and mustard seed were included in the ancient herbal medicines, prescribed to remove fat and to cure urinary complaints, piles and jaundice (Rosengarten 1969). The antiquity of its use in India is suggested by the fact that the living plant and dried rhizome are known by different names.

According to the historical records of Hoffman, ginger was certainly known to and highly esteemed by, the ancient Greeks and Romans who obtained the spices from Arabian traders. Greeks and Romans considered it as an Arabian product because they got it via Red Sea. Some historians have recorded that the Prophet Mohammed had once relished a piece of sweet meat flavoured with ginger and had explained that the gift came from India. The name Zingiber seems to be derived from Sanskrit 'Sanjabil' through the Arabic 'Zanzabil'.

World scenario

The total production of ginger in the world is 1,683 thousand tonnes with the total acreage of 310.43 thousand ha. China, India, Indonesia, Nepal and Thailand are the major producers of ginger in the world, having production of 396.60, 385.33, 210.79 and 172.68 thousand tonnes respectively. India and Indonesia have the largest area under cultivation. (107.54 and 60.47 thousand hectares)

Indian Scenario

There is only marginal increase in acreage from 108.64 thousand ha in 2008-09 to 149.10 thousand ha in 2010-11. However the production has increased from 380.10 thousand tons in 2008-09 to 702.00 thousand tonnes in 2010-11. The details are given in table.

Ginger in Karnataka

In Karnataka the total production of ginger is 14.7 thousand tons with the total acreage of 1.7 thousand ha and productivity is about 9.3 kg/ha.

Ginger production is likely to increase substantially as good returns have prompted by Kerala farmers to lease-in more land for its cultivation in Karnataka. Returns from the crop have more than doubled in the last one year and more and more entrepreneurs are looking at it as a lucrative option. Currently, Coorg in Karnataka is leading in ginger cultivation followed by Hassan and other

neighbouring districts. Ginger prices are currently at a higher level and almost double the level traded a year back. Shortage in China and lesser imports from Nepal has created a supply crunch in market while demand is seen growing at a healthy pace. Ginger transported to North India has increased dramatically. Demand has also gone up due to entry of big retailers and refrigeration facilities. Currently, dry ginger is trading above Rs 200 per kg and has even touched to Rs. 240 for the premium grade. Ginger is quoted above \$5,000 per tonne in the global market and closely followed by China.

Ginger products and its uses

Ginger has numerous applications in the food, beverage and pharmaceutical industries. There are two primary products of the ginger rhizome, fresh ginger and dried ginger. Fresh ginger is consumed as a vegetable. The dried products are the major form in which ginger is internationally traded. Dried ginger is used directly as a spice and also for the manufacture of products like ginger powder, ginger oil and ginger oleoresin.

Ginger Powder

Ginger powder is made by grinding the dry ginger to a mesh size of 50-60 mm. The use of ginger powder in pure form is limited but it is considered as an important ingredient of curry powder. It is also used in ginger beer, wine and baked goods.

Ginger Oil

The characteristic pleasant aromatic odour of the ginger is due to the presence of essential oil. Ginger oil is obtained by steam distillation of dry ginger. Formerly, the oil was produced exclusively in U.S.A. and Europe, but later commercial production has been undertaken by some of the spice producing countries, notably in China, India, Australia, Jamaica and Indonesia from their own forms of dried ginger. The essential oil obtained from ginger is greenish and

yellowish in colour and possesses the characteristic odour and aroma of the produce. The oil is extensively used in the food and perfume industries.

Ginger Oleoresin

The spice flavour value of ginger is due to two factors viz., the volatile oil contributing the aroma and the resinous non-volatile portion responsible for the pungency. Oleoresin is the total extract which contains both volatile oil and pungent extractions. This is prepared by extraction of powdered dry ginger with suitable solvents like alcohol, acetone or any other efficient solvent. The solvent is then distilled off to get the highly coloured concentrate. Ginger oleoresin is a dark brown viscous liquid with a volatile oil content which can vary from 15 to 35 per cent. The amount of essential oil is an important factor in evaluation of oleoresin. In the trade, it is known as 'gingerin.' Ginger oleoresin is manufactured on a commercial scale in India and abroad and is in great demand in various food industries. The oleoresin is used in many types of baked goods, sauces, sweets, soft drinks and alcoholic beverages.

Preserved Ginger

The major types of preserved ginger are ginger in brine, preserved in syrup and crystallized ginger and ginger candy. The ginger is used for above purpose should be less fibrous type, mild in pungency and harvested at a tender stage. Ginger preserve and ginger candy are favourite items in many countries in West as well as in Australia and Japan. In India, ginger murabba is a choice of many, especially in the northern parts of the country. However, the quantity of ginger used for preservation is very low as compared to the country's production.

Other Uses

Ginger is widely used for flavouring a great variety of foods. In Western countries, ginger is used for culinary purposes. In the West Asian countries like Saudi Arabia, ginger is used mainly in the preparation of ginger coffee. Again, in U.S.A., U.K. and Canada, ginger is widely used in meat processing industries. A number of alcoholic beverages are prepared from ginger, such as ginger brandy, ginger wine, ginger beer and ginger ale.

There is a saying that 'No kashayam without dry ginger. In India, ginger is largely used in ayurvedic medicine preparation. Ginger is extensively used in winter for curing minor ailments like cough and cold. It is also prescribed as an adjunct of many tonic and stimulating remedies. Veterinary uses of ginger are as stimulant and carminative, in indigestion of horses and cattle and in spasmodic colic of horses.

Need for the study

Ginger is one of the important spice crops cultivated in India. The farmers of Karnataka are cultivating this crop on commercial scale. Ginger is cultivated extensively in Mysore district. It accounts for 3.56 per cent of the total area in the state. It stands third in respect of area and production. Studies pertaining to economics of ginger have not been attempted so far in the district. Land leasing activity has been going in the district in ginger cultivation for decades. The farmers of Kerala are thronging the district particularly the taluks of Hunsur and HD kote for taking lands on lease basis and cultivate ginger. Land leasing activity is hectic in these taluks. The crop is gaining prominence in the recent past contributing to regional economy. The crop is highly exhaustive depleting plant nutrients rendering soil unfertile or infertile. The study envisages studying sustainability of ginger cultivation in Mysore district. The findings of the study are useful to farmers to make decision as to grow the crop continuously year after year or to rotate with the other crops so as to

maintain soil fertility. It also helps policy makers to formulate policy capsules as may be necessary to promote or restrict ginger cultivation in the state.

Specific Objectives of the study

- To examine the land use and lease pattern in ginger cultivation.
- To study the comparative economics of ginger cultivation in leased-in and owner cultivated lands.
- To assess the resource use efficiency and its implication on sustainability in ginger cultivation.
- To document the opinion of farmers regarding the problems and prospects of ginger cultivation.

The hypotheses outlined for the study are:

- Land leasing activity is most prevalent in ginger Cultivation.
- Ginger cultivation is more profitable/ remunerative on leased-in farms than owner-operated farms.
- Ginger cultivation is unsustainable in the study area.
- There is difference in efficiency of resources between the two categories of farms.

Limitations of the study

The present study mainly relied on the primary data collected through sample farmers. There was no maintenance of any record regarding the cultivation expenses, application of inputs, and returns. Some amount of recall bias is bound to be associated with the collected data. However, efforts were made to minimize them through cross checks at the time of data collection.

Sustainability in the context of environment is a concern for continuity of particular production system. Time element is very crucial dimension in this regard. However, the sustainability analysis undertaken in this study do not consider time element due to non availability of data over the years. It focuses only on special dimension

by taking certain sustainability indices. It would be essential to study sustainability which has test of significance over sufficiently longer period. Hence these results are indicative in this regard.

Presentation of the study

- The study is presented in 7 chapters. The first chapter presents introductory part, origin, history, importance, area and production of ginger. This also gives an account of scope and need for the study along with the objectives and hypothesis.
- The second chapter provides detailed review of literature pertaining to the study under various heads objective wise viz., land leasing pattern, economics of the crop, resource use efficiency, sustainability of the crop and constraints regarding the cultivation of crop.
- Third chapter deals with methodology covering the features of the study, area, sampling design, collection of relevant data and analytical tools used in the study.
- Fourth chapter deals with results and main findings of the study through tables.
- Fifth chapter reveals discussion part of the study.
- Chapter sixth provides summary, conclusions and the policy implications arising from the findings of the study.
- Last seventh chapter gives the list of literature referred.

Future line of work

Environmental sustainability of soil where intensive cultivation of ginger taken place for considerable year need to be assessed involving scientists from multidiscipline's including soil science, entomology, plant pathology. Such a over use of agrochemicals and water definitely needs environmental unsustainability problem called as negative externalities in natural economics. A thorough investigation and corrective measures along with compensating mechanism needed in order to restore the health.+

II. REVIEW OF LITERATURE

Review of literature gives the guidelines from the past researchers and provides foundation to the theoretical frame work for the present investigation. The review of past literature makes the investigator to get an insight in to the methods and procedures to be followed. Since the available literature relevant to the objectives of the present study were rather limited, the studies related to other crops or technologies were also reviewed and presented under the following headings.

2.1 Land use and land lease pattern of ginger cultivation.

2.2 Cost-return analysis.

2.3 Sustainability.

2.4 Resource use efficiency.

2.5 Problems/constraints associated with ginger cultivation.

2.1 Land use and land lease pattern of ginger cultivation.

Ramanaiah *et al.* (1990) reported that the importance of forest land use in Andhra Pradesh was second only to agriculture. The increase in percentage of forest land in the state during the period from 1963-64 to 1978-79 was negligible. The non-cultivable land in the state showed an increase from 14.9 percentage of the total area in 1963-64 to 16.4 per cent in 1978-79, thus showing a net increase of 1.5 per cent. Between 1963-64 and 1978-79, the percentage of cultivable wasteland in the state had decreased by 1.8 per cent and the arable land in the state showed a marginal decrease of 0.1 per cent.

Pal and Mruthyunjaya (1990) studied silvipastoral system for development of wastelands of arid areas in Rajasthan using the time series data of 16 years from 1970-71 to 1986-87. The compound

growth rate revealed that the area under forests, grazing land, cultivable wasteland, gross cropped area and area sown more than once registered a significant positive growth during the study period. The growth rate was highest for forests (4.16%) followed by area sown more than once (4.10%), the growth rate for barren and uncultivable land was negative and significant. They suggested a land use plan for the development of arid areas of Rajasthan which envisaged that the proportionate area under crops should decrease from the existing 44.98 per cent to 33 percent of total area. The leased land was to be utilized for forests, grasslands and fruits.

Singh (1990) studied the land use pattern in the problematic areas of all the five agro climatic regions of Uttar Pradesh, during the year 1988-89. The study revealed that the hill region had the highest area under forest, permanent pastures, grazing land, tree crops and groves, non-cultivable wastelands and land under non-agricultural uses. The area sown more than once and the total cropped area, as well as the intensity of cropping had been found to be the highest in the eastern region and the lowest in the hill region. He concluded that the slopes of the hilly areas of UP could be successfully developed for the plantation of temperate fruits.

Ratnareddy (1991) studied the trends of under utilization of land in the districts of Andhra Pradesh for a period of 33 years from 1955-56 to 1987-88. The study showed that the underutilized lands included current fallows, other fallow, and cultivable waste and grazing and pasture lands. The analysis suggested that under utilization of land was associated with irrigation, tractors, commercialization and such other factors. Such under utilization was attributed to the inability of the farmers to adjust to higher demand for resources. He concluded that land utilization largely depended on the availability of resources. He also concluded that land utilization largely depended on the availability of resources with the farmers and the nature of investment in relation with the expected returns.

Shrivastava *et al.* (1991) studied the dynamics of land use and cropping system in the Tawa Command Area of Hoshangabad district of Madhya Pradesh. They assessed the impact of the Tawa irrigation project on cropping pattern and land use in the area during the pre-project period (1963-71 to 1974-75) and the post project period (1975-76 to 1979-80). They observed a decline in the forestland as a result of illegal felling of trees for domestic purposes. They also reported that fallow land had increased since the introduction of the Tawa irrigation project.

Singh and Kaur (1991) studied the changing pattern of land utilization in Punjab since the inception of new farms technology in the mid sixties i.e. from 1966-67 to 1987-88. The study revealed that the reported area for land utilization remained constant while the area under forests, area not available for cultivation and net area sown increased during the period. Due to intensification of agriculture, gross cropped area and cropping intensity increased. He concluded that Punjab agriculture had recorded drastic structural changes since the beginning of the green revolution.

Vaidya and Sikka (1991) studied the land utilization pattern in Himachal Pradesh using secondary data for the period from 1966-67 to 1986-87. They observed that there had been no uniform trend in the changes in the land use classes. The area under forest showed an increasing trend while that on other categories had shown a declining trend. They have projected the land use pattern for the 2000 on the basis of compound growth rate calculated using the collected data. The projection revealed that the area under all categories except current fallows would show an increase.

Padmanaban and Chinnadurai (1994) studied the land use pattern in Tamil Nadu for the period 1960-61 to 1988-89. They reported that the total cropped area in Tamil Nadu has declined from 7.32 million hectare in to 6.44 million hectare during the period and

the area sown more than once declined from 1.32 to 0.90 million hectare during the same period. Over the years, the total cropped area has been consistently declining, at the same time the area under current fallow, other fallows and lands under non-agricultural use increasing year by year.

Rajesh and Ramasamy (1998) studied the trends in under utilization of land in Tamil Nadu and identified the determinants for the same. The results indicated that there is a greater scope for further extension of area of land under cultivation, as the existence of vast area of land under current fallow, other fallow and cultivable wastes which can be brought under cultivation in Tamil Nadu. They reported that the prevalence of landlordism or large holdings has been responsible for the high percentage of land uncultivated, as the high percentage of land is not cultivable in large size operational holdings. The resource crunch faced by the farmers seems to have aggravated after the advent of new technology due to the capital-intensive nature of modern inputs. This has led to the neglect of other lands.

Prashantkumar (2003) studied the land use pattern in three dry zones of northern Karnataka and the results showed that there was a decline in the area under non-agricultural uses, cultivable waste, current fallow and other fallow land in the case of zone-I and in the area under non agricultural uses, cultivable waste and net are sown in zone-II. There was a positive growth in barren and uncultivable land, current fallow and other fallow lands in zone III. The share of area under cereals increased in the case of zone-II and zone-III.

Sreeja (2004) studied the change in land use pattern in Kollam district of Kerala. The results indicated that there was a substantial growth in the current fallow, which reflects the consequence of year to year rainfall variations showing inverse relationship between rainfall and current fallow. Barren and uncultivated land, permanent

pastures, land under miscellaneous tree crops and groves and cultivable waste recorded a significant negative growth.

Vasant P. Gandhi (2006) the paper examines the rural land and labour markets in the context of economic liberalization in India. Land and labour are the two fundamental resources available to the rural people for income generation. The access to land and to employment for labour becomes basic determinants of well-being for the rural households. Reforms are often seen as hostile to rural areas and the poor, although they should be beneficial not only for overall growth, but also rural growth and poverty alleviation. The study based on primary household data examines the land and labour markets in the reform period and the underlying linkages of these two different characteristics of the household. The study finds that over the reform period in India the land markets are leading to less landlessness rather than more, and growth in marginal and medium farms sizes rather than large. Lease markets are leading to operated land in more hands. Land purchase behaviour is related to less land, more education, greater crop diversification, and higher crop and livestock revenues. Leasing is also related to many of the same variables and is showing great diversity in lease agreements involving outputs, inputs and rent. Labour-employment is showing diversity of occupations but the primary dependence on agriculture is still about 80 percent. There has been some change in the occupational structure. Non-farms employment is associated with higher overall employment. Own farms employment is strongly related to crop diversification and livestock activity; other farms employment to number of male and female family members and irrigation; and non-farms employment to education. Broadly, liberalization does not show adverse consequences but rather some positive impact on rural land and labour markets

Sonika Gupta and Sharma (2010) in their study has been undertaken with the objectives of finding the extent of land degradation and its determinants in the mountainous regions of

Himachal Pradesh by dividing the state into four zones. Multistage random sampling technique has been adopted to select the sample farmers from each zone. Logit analysis has been carried out to find the probability of different factors affecting land degradation. The factors whose effect on land degradation has been reported are: total owned land, land fragmentation, family labour, non-farms income, farms income, migration, leasing-out of land and education level of members in a household. The study has suggested some measures to minimize land degradation and consequently increase production and income levels in this difficult terrain of the country.

2.2 Cost-return analysis.

Mahabala (1990) conducted a detailed survey of cardamom growers in Mudigere taluk of Chikmagalur. He reported that, on an average, small farmers received a higher price per kg of cardamom sold when compared to the price received by large farmers though, the total returns from both, small and large farms showed a declining trend over the years.

Singh *et al.* (1990) studied the cost and returns of intercrops, in arecanut in Kerala. The study was conducted in respect of five major intercrops viz., banana, betel vine, ginger, pineapple and turmeric grown by growers in order to estimate the cost and profit margins of the plantations. The results showed that in terms of net income, betel vine was the most profitable intercrop with a net income of ₹ 12,080 followed by pineapple (₹ 8,050), ginger (₹ 7,550), banana (₹ 6,880) and turmeric (₹ 5,580).

Korikanthimath (1992) conducted a study on the compatibility and productivity of Arabica coffee with cardamom at Chettalli, northern part of Kodagu district, Karnataka and the results showed that the cost of cultivation incurred during the third year was highest in mixed cropping and was 2.34 times more than the monocropping of Arabica. The gross returns were ₹ 1,17,901 per hectare in mixed

cropping and 171.07 per cent more than the monocrop and the economic aspects revealed that the discounted gross returns and cost of cultivation were more in mixed cropping than in monocropping of Arabica coffee. This clearly indicates the relative superiority of mixed cropping over monocropping and feasibility of cultivation of combination of compatible crops.

Korikanthimath *et al.* (1994) studied the multi-storeyed cropping system with coffee, clove and pepper in Coorg district of Karnataka. The study revealed that, in the above crop combinations, some of the common cultural operations like weeding, mulching etc. can be commonly shared together, thereby bringing down the total cost of cultivation. The crops in the above combinations do not press for labour at a time. Coffee can be harvested during December-January followed by clove in March and pepper in April. Thus, there is a vast scope for the introduction of clove and pepper in coffee plantations.

Kaul (1997) studied the status of production and marketing of horticultural produce in India and reported that the income from the horticultural crops has been steadily increasing. It increased by about 300 per cent between 1970-71 and 1984-85 and by over 78 per cent between 1985-86 and 1995-96. These crops claimed a share of 34.50 per cent of the total value of the agricultural produce despite horticultural crops covering only 7.20 per cent of the gross cropped area.

Korikanthimath *et al.* (1997) studied the economics of mixed cropping in coconut with cardamom in Chikmagalur district of Karnataka and revealed that the cost of cultivation was the highest (₹ 35,000/ha) in mixed cropping as against ₹ 18,272 per ha under monocrop of coconut. The net returns of ₹ 1,01,017 per ha in the mixed crop was 2.5 times higher than that of the monocrop of

coconut. The incremental net gain was ` 60,697 per ha (150.54 per cent) in mixed cropping.

John (2000) in his study on the prospects of pepper as inter crop in coffee plantations in Karnataka, revealed that pepper is generally grown as a mixed crop with coffee, arecanut and coconut. Among the combinations, coffee and pepper was found to be the best and each did not interfere with others production. Arabica and robusta were the major coffee varieties grown and pepper production was found to be excellent with robusta coffee probably due to lesser shade requirement for robusta.

Bhatt *et al.* (2001) studied the effect of mixed crops on arecanut yield. The study was conducted at the Central Plantation Crops Research Institute; Regional Research Station at Vittal, Karnataka and the results revealed that growing cocoa and clove as mixed crops either individually or in combination did not reduce the arecanut yield.

Nampoothiri and Sairam (2001) conducted a study on the economics of arecanut and coffee mixed cropping system in Kasaragod district of Kerala. The results showed that coffee was a suitable mixed crop for arecanut garden under the existing market prices and arecanut+coffee mixed cropping system provided additional net revenue of about ` 35,710 per hectare over arecanut monocropping which was about ` 1, 28,350 per hectare.

Varghese (2003) analyzed the production and productivity of cardamom in Kerala and observed that there is a massive crop shifting. The small and marginal farmers have already quit cultivation and opted for more competitive and remunerative crops like vanilla and if the process is continued, the cardamom hills will disappear in the near future. He also suggested that the Government and the Spices Board should ensure that the cardamom estates that was formed under the CRC (Cardamom Registration Certificate) are

growing only cardamom, for which proper monitoring and ample financial support is necessary.

Varghese (2003) studied the reasons for declining cardamom cultivation in Kerala and observed that the hidden hand of environmental degradation is a grave danger especially on the sloppy terrain solely affecting cardamom yields. The environmental degradation mainly due to deforestation has led to large scale soil erosion and changes in micro climates which have adversely affected productivity and fruit setting in cardamom, thereby lowering the yields. He has suggested a watershed management approach for the sustainable development of the crop.

Varghese (2004) made an attempt to work out the costs, returns and profitability of cardamom plantations in Kerala. He observed that the cost of production per unit (cost per kilogram) was very high in small size plantations as compared to large size groups and suggested a concrete action plan for creating awareness among the planters as well as cultivators with regard to recommended packages of cultivation.

Shinoj and Mathur (2006) conducted a study to estimate demand elasticity's and project demand for spices till the year 2015. The results inferred that the expenditure elasticity's of spices in India were positive and inelastic during the period 1987-88 to 1999-2000. The expenditure elasticity's have been relatively higher for lower income classes, suggesting that a positive income change would motivate consumers in that class to spend more on spices compared to their higher income counterparts. The demand projections showed that the household consumption demand for spices is on an increase in the coming years.

Hema *et al.* (2007) undertook a study to examine the production performance and to analyse the price behaviour of black pepper in Kerala state. This study revealed that during the past three decades,

area under all spices has almost doubled from 1.32 million hectares in the early 1970s to 2.52 million hectares in 2002. It was felt keeping the volatile spice prices in view; specific policies for integrating farms harvest price with retail price will not only help the producers but also make spices somewhat more affordable to the domestic consumers. She also opined that the assured price mechanism as extended to other cash crops will fetch a great deal in assuring economic profit realisation by farmers and will retain their interest, as they are hard hit in the event of any eventuality on the price front.

Lwasa and Bwowe (2007) studied the economic potential of cardamom as an alternative income source for the farmers of Uganda. His work revealed that cardamom is not a quick paying back crop since positive returns are realized in the third season and the high establishment costs act as disincentive for the adoption of the crop. Further the study reported that the crop's potential is yet to be fully exploited as many small holder farmers are still inefficient.

Shashikumar (1993) studied the economics of betel vine in Chitradurga and Chikmagalore district of Karnataka state and reported that the total cost of cultivation of betel vine amounted to Rs. 65,070 in medium, Rs. 61,241 in small and Rs. 60,463 in large gardens. About 32 per cent of the cost is accounted for the labour cost. Harvesting was the labour incentive operation among various operations.

Shah and Zala (2006) estimated that ginger is a highly capital-intensive crop and the average cost of cultivation has been estimated to be Rs 2,02,260/ha based on the data collected from 128 ginger growers spread over 16 villages of four talukas, covering two ginger-growing districts of the middle Gujarat region during 2004–05. The average paid out cost has been found as Rs 1, 57,368. The cost on seed has been found highest (Rs 64129/ha) constituting about 32 per cent of total cost, followed by human labour (18.04%), organic

manures (10.79%), and irrigation charges (10.32%). Human labour requirement for ginger cultivation has been found to be of 730 man days/ha. The average yield of ginger in the study area has been found as 133 q/ha. The overall gross returns, farms business income, family labour income and farms investment income have been estimated to be Rs 3,82,600, Rs 2,25,230, Rs 2,17,100 and Rs 2,03,139 per hectare, respectively. The net profit per hectare over cost C2 has been found as Rs 1, 80,338 and input-output ratio as 1:1.97 on the basis of cost C2 for all farms. The overall cost of production has been found as Rs 1,566/q which was much lower than the market price, Rs 2,000–5,000/q, during the study period, which indicates that the ginger cultivation is quite remunerative in the area even at the lowest price.

2.3 Sustainability

Tisdell (1988) referred sustainability to the propensity of the system to withstand collapse under stress. It refers to robustness or continuing viability of a system or low vulnerability. He pointed out that some systems might be highly productive but subjected to substantial risk as far as their sustainability is concerned.

Jodha (1991) listed the negative changes related to resource base production flows and resource management as indicators of unsustainability. Some of these indicators included were prolonged negative trends in yields of crop, livestock etc, increased input need per unit production, reduced average productivity of different crops etc. He also revealed that sustainability could be achieved through application of modern technology blended with rationale of indigenous practices. They measured the change between using a technology and not using it. Variables that demonstrated changes in sustainability like nutrient retention were further analysed with the help of spatial interception.

Dunlop *et al.* (1992) attempted to arrive at a comprehensive definition of sustainable agriculture based on indicators and subjected

14 dimensions to faculty judgement. Among them nine dimensions viz., protect and enhance site-specific knowledge of farmers, enhance environment and wild life habitat, increased biodiversity, improved farms economy, reduced energy use and reduced agrochemical use and reduced purchase of inputs has been considered as most important in explaining the concept of sustainable agriculture.

Chakravarthi and Baig (1992) discussed the total factor productivity approach to measure sustainability and noted some of the substantial drawbacks that the method had. Not least of these were the difficulties associated with accurately measuring the value of the inputs and the value of the outputs. In order to avoid this problem they suggested a method which measures sustainability qualitatively. They measured the change between using a technology and not using it. They suggested that variables that demonstrate changes in sustainability like nutrient retention could be further analyzed using spatial interpretation.

Dubey (1993) examined the existing production pattern and resource use in agriculture, evolved alternative production strategy for sustainability of agriculture and analyzed the constraints on agricultural sustainability based on data collected from farmers of Jaunpur district of Uttar Pradesh. Existing resource use pattern in agriculture and other activities were studied. Low external input use in agriculture was found to be a common practice in the area. Thus the study concluded that the existing technology widened the scope of sustainability of agriculture due to low use of external inputs in it.

Gowda (1996) estimated sustainability of rice farming in different ecosystems viz irrigated, lowland, upland and tank fed ecosystems of Karnataka. Components of ecological dimension included in the study were nutrient management, water management and integrated pest management. Components of economic dimension included were crop yield security, land productivity and input

productivity. Components of social dimension included were information self reliance, input self sufficiency and family food sufficiency. The overall mean sustainability index was worked out as 50.28 indicating modest sustainability of rice farming as a whole.

Kiresur *et al.* (1996) estimated the sustainability of improved oilseeds crop production technologies against the existing local farmer's practices. They used a site specific index to measure the sustainability of an improved technology. For a given crop growing situation, the site index can be computed for each selected field adopting farmer's practices by taking deviation of yield per unit area from the overall mean of all such sample fields adopting farmer's practices. They worked out the sustainability index for the demonstrations conducted in groundnut by Dharwad centre of Karnataka. They also worked out sustainability index for other oilseeds and concluded that magnitude of yield or economic returns realized by adopting improved crop production methods are only of limited use in assessing sustainability of improved technology. The variations in yield levels realizable from the prevailing farmer's practices and an estimate of the response of the yields or returns from improved technology to the site index are important factors to be considered for evaluating sustainability of any improved crop production technology.

Madhusudanan (1999) assessed the sustainability of coconut and rubber production systems in Kerala. She categorized the farmers into sustainable and unsustainable groups based on cost and yield levels and found that percentage of farms classified under sustainable group was higher in coconut at 33.81 per cent as against 21.42 per cent in rubber. She worked out various sustainability indicators. The co-efficient of variation in return to cost ratio was higher at 4.62 per cent for rubber compared to 4.16 per cent in case of coconut. Percentage of cost of eco-friendly inputs to total cost of cultivation was higher at 8.22 per cent in coconut as against 4.99 per cent in case of

rubber. Percentage of cost of natural inputs was 54 per cent Of total cost of cultivation in coconut as against 45.08 per cent in case of rubber. Plant protection chemicals and fertilizers constituted 16.16 per cent of total cost in coconut as against 27.48 per cent in case of rubber. The ratio of purchased inputs to own inputs was worked out as 3.81 for rubber and 1.98 for coconut. Price variability was more for rubber compared to coconut. Based on these criteria it was concluded that coconut production was more sustainable than rubber production.

Sreenivas (2000) analyzed the economic sustainability of farms under four different zones in and around Biligiri Rangaswamy Temple wild life sanctuary in Chamarajanagar district of Karnataka. He used ratio analysis for determining the economic sustainability of farms. The ratios used were ratio of cost of eco-friendly inputs to the total cost of cultivation of major crops, ratio of cost of purchased inputs to the total cost of cultivation of the crop and percentage of cost of commercial pesticide in the total cost of cultivation of the crop. From the results it was concluded that zones one and two were relatively more sustainable both economically and environmentally than zones three and four.

Krishna (2001) studied the sustainability of rice farming in the agro-ecological problem area zones of Kerala. The composite sustainability index worked out using multi-criteria approach was 0.55 for Pokkali tracts and 0.49 for Kuttanad tracts. Ratios indicating sustainability status of rice cultivation was also used to cross check the sustainability index. The temporal sustainability was also assessed using partial productivity and growth rate analysis. The results revealed Pokkali tracts to be more sustainable than Kuttanad tracts.

Somashekarappa (2002) studied the sustainability of different farming system among different categories of farmers using multi

criteria approach developed by Abazzo and Boggia (1998) after modifying to capture the specific features of different farming systems. The six components used to calculate the sustainability index were gross income per hectare, benefit cost ratio, fertilizer productivity, pesticide productivity, percentage cost of ecofriendly inputs in total cost of cultivation and ratio of cost of owned inputs to the total cost of cultivation. The study revealed that medium farmers had higher sustainability index of 0.87 followed by small farmers with 0.78. The marginal farmers had sustainability index of 0.71 and large farmers were relatively unsustainable with sustainability index of only 0.56.

Jorge d. de prada *et. Al.* (2003) the trade off between short-term agricultural productivity and sustainability is examined with a statistical analysis of evidence from low input agriculture in Argentina. Estimation results show that more intensive land use, corporate leasing of land, and larger farms size are likely to increase current revenues, but at the cost of sustainability.

Bhatia (2006) the pattern of development and trends in productivity and profitability have been analysed to find whether Indian agriculture meets the requirements of sustainable development. The study is based on the secondary data culled from the publications of the Department of Agriculture and Department of Statistics, Govt. of India. A tremendous development and spectacular growth have been observed in agriculture during the past five decades, 1949-50 to 1999-2000. However, there has not been any spectacular modification in the technology since 1980s, leading to a continuous deceleration in the rates of growth of both production and productivity of most crops in recent years. Because of decline in yield, the economic condition of farmers has deteriorated. On the other side, non agricultural sector has shown a growth of 6 per cent. This increasing disparity between per capita income of agricultural and non-agricultural sectors is likely to raise social disorder in the farming class.

Pradhuman and Mittal (2006) the sustainability issue of the crop productivity is fast emerging. The post-Green Revolution phase is characterized by high input-use and decelerating total factor productivity growth (TFPG). The agricultural productivity attained during the 1980s has not been sustained during the 1990s and has posed a challenge for the researchers to shift the production function upward by improving the technology index. It calls for an examination of issues related to the trends in the agricultural productivity, particularly with reference to individual crops grown in the major states of India. Temporal and spatial variations of TFPG for major crops of India have also been examined.

2.4. Resource use efficiency

Panda (1996) examined the nature of technical and allocative efficiency of sericulture farms in Tamil Nadu state. A sample of 120 sericulture farmers from 12 villages in two districts; Dharmapuri and Dindigal were selected. A Cobb-Douglas type of production function was estimated using ordinary least squares. Production function analysis revealed the scope for increasing cocoon productivity through increased use of disease free laying, better silkworm germplasm and efficient use of labour. Farms-specific technical efficiency and input-specific allocative efficiency exhibited scope for minimizing inefficiency. One of the major constraints to sericulture development was inadequate trained manpower. To improve productivity and efficiency, extension support in mulberry cultivation and silkworm rearing technology were recommended to be strengthened with the development of infrastructure facilities.

Patel *et al.* (1997) analyzed 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 28.69 per cent of yield gap between the potential farms and

sample farms. The contribution of production technology to the yield gap was comparatively less (3.42 per cent). This meant there was a limited scope for exploiting the untapped farms potential through improved production practices. The difference in input use was found to contribute more (25.82 per cent) to the productivity difference. There is 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 per cent) among the inputs, while, the contribution of plant protection chemicals was negative. This implied that reduction in the expenditure on the latter would result in a higher output on the farmers' field.

Chandran *et al.*, (2001), studied Resource use efficiency in pepper cultivation in Idukki District of Kerala. From sample of 117 pepper cultivators information about pepper cultivation was collected. Cobb-Douglas production function was used to assess resource use in pepper production. The study revealed that labour, manures & fertilizers and age of plants were important yield determining variables having output elasticity's as 0.672, 0.14 and 0.38 respectively. It was also found that labour; manures & fertilizers and plant protection chemicals were having low allocative efficiency and greater scope to increase their use.

Gaddi *et al.* (2002) using output decomposition model, estimated contribution of different sources to yield gap in cotton was estimated. The variables included in the model explained more than 87 per cent of the variation in cotton production in demonstration field. Human labour, bullock labour and seeds turned out to be the most important variables governing production. Capital input did not exert any significant influence in cotton production, while the plant nutrients were excessively used. The production elasticity's of all inputs on all the farmers' fields were invariably lower than unity

implying diminishing marginal productivity with respect to each of these inputs.

Abhay *et al.* (2004) analyzed the efficiency of input use in tobacco production in Turkey with respect to sustainability. The provinces in the Aegean, North-western, Eastern-South-eastern Anatolian and Black Sea regions were considered. Face-to-face interviews were carried out with 300 farmers from the provinces. Data Envelopment Analysis (DEA) calculated efficiency measures of tobacco farms in each region. The average technical efficiency score for all regions was found to be 0.456, implying that the same level of production per plot can be obtained even if the inputs used for tobacco production are decreased by 54.4 per cent. The results also indicated a strong positive relationship between the efficiency of input use and the sustainability of agriculture.

Sarker and Sudipta (2004) attempted to examine the extent of efficiency under different types of tenure and different farms sizes in two types of villages-technologically advanced villages in agriculture, having high incidence of irrigational and HYV facilities in area usually cropped twice every year and technologically backward villages having no irrigational facilities and HYV facilities in a mono-cropping area. Data Envelopment Analysis was employed to estimate efficiency levels. It was seen that most of the farms were ideally efficient. No farms in the sample had efficiency score of less than 0.98. Use of high technological inputs in agriculture was not so important in improving the efficiency level of the farms. Considering all farms sizes in both types of villages together, it was seen that except the lowest farms size where all farms were efficient, the proportion of efficient farms increased with the increase in size.

Suresh and Keshava Reddy (2006), Studied Resource use efficiency of paddy cultivation in Peechi command area of Thrissur District of Kerala. The study was based on sample of 71 farmers. The

results indicated that elasticity co-efficient for chemical fertilizers; FYM and human labour were significant and positive. At the same time allocative efficiency indicated that marginal returns per rupee increase in this would be Rs 2.83, 1.57 and 1.17 respectively.

Dipeolu (2011), Despite increases in the cultivation of pepper among farmers in South-West Nigeria, massive transportation of pepper from the Northern parts of the country and seasonal fluctuation in prices are still very common. Given a good knowledge of the efficiency levels of various production units (farms), output can be increased in the short-term by improving production efficiency. This study examined technical, allocative and economic efficiencies in pepper production in south-west Nigeria. Data were collected from three hundred pepper farmers. Data were analyzed using the stochastic frontier approach. The results revealed average technical, allocative and economic efficiencies of 0.737, 0.893 and 0.658 respectively. These imply that given the present efficiencies levels, there is room for the average farmer to increase pepper output or save costs without the need to change existing technology. Extension contact, gender, indigene ship status, age and household size have significant effect on technical inefficiency. The study recommended among others, intensive extension services which focus more on native, older and female farmers and are geared towards raising technical knowledge of pepper farmers in order to improve output significantly.

2.5 Problems/constraints associated with ginger cultivation.

Kennedy *et al.* (1990) investigated production constraints in growing the three crops namely black gram, red gram and bengal gram in Guntur district of Andhra Pradesh. Garret's ranking technique was used to test the severity of production constraints. The constraint ranked as of highest importance by farmer was lack of technical knowledge regarding pulses cultivation.

Makanga and Singh (1997) reported constraints for low level of mechanisation in Kenya, particularly in small-scale farming where the use of hand tools are most common. Major factors responsible for low level adoption of agricultural mechanisation technologies include small size of holding, inadequate capital, technological adaptability, product pricing structure and marketing, extension and adult education, problems related to transition to animal power, soil and water erosion, machinery operation and maintenance and lack of required infrastructure.

Kumar *et al.* (1999) identified the constraints in the gherkin production in Dindigal. The problems in gherkins production as perceived by the farmers were ranked based on the scores using Garret's ranking technique. The results revealed that the availability of trained labour, marketing facilities, pest and diseases were the major constraints, followed by capital and soil fertility.

Nagaraj *et al.* (1999) identified the most important constraints in production and marketing of potato in Kolar district of Karnataka by assigning the ranks. In production, high cost of seed material and disease (rank-I) where the major constraint followed by the frequent power failure (rank-II), high cost of fertilizers and plant protection of chemicals (rank-III), scarcity and high cost of laborers (rank-IV) and non availability of good seed material on time (rank-V), low output prices (rank-VI) and high market charges (rank- VII) were the main constraints in the marketing. Under the circumstances, it was suggested to adopt scientific production technologies and marketing strategies to get maximum returns.

Smitha (2004) studied the major problems in production by anthurium growers in Coorg districts if Karnataka. High cost of the planting materials and the huge initial investment required for the cultivation of anthurium, the problem of pests and disease attack and also the low light intensity during winter season were considered to be

important problems which reduced the productivity of crop drastically during winter.

Reza (2005) studied the main constraints in the production and marketing and trade of pistachio in Iran. High cost of production, unstable domestic market, low productivity the non-availability of required quantity and quality of planting materials and incidence of pest and diseases were the major constraints in the production and trade. As water shortage and salinity are the major constraints in production and it also caused reduction in orchard productivity and in another side it entailed a high cost of water pumping and all other allied costs to the farmers.

Rama Rao (2011), the study has assessed the Economics and Sustainability of SRI method and traditional methods of paddy cultivation in North Coastal zone of Andhra Pradesh. Cobb - Douglas type of production function was used to assess the factors affecting the production of paddy in both SRI and traditional methods. The results 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 stronger effect than input use(10.85%). The most important constraint in SRI cultivation has been identified as 'nursery management'.

III. METHODOLOGY

This chapter presents the details of description of the study area, selection of samples, nature of data, method of data collection; conceptual framework and analytical tools employed in the present study and is organized under following four sub heads.

3.1 Description of the study area.

3.2 Sources of data and sampling design.

3.3 Analytical tools and techniques.

3.1 Description of the study area.

3.1.1 General characteristics of the study area

The present study was undertaken in Mysore district of Karnataka state during the agricultural year 2012-13. Mysore district is situated between 11°30' N to 12°50' N latitudes and 75°45' E to 77°45' E longitudes. It covers an area of 6854 sq. km. that is, 3.57 per cent of the state's total geographical area. Mysore district lies between malnad and semi-malnad range at an altitude of 610 meters from the mean sea level. The district forms the southern part of the Deccan peninsula with Tamil Nadu to its southeast, the Kodagu district to its west, Mandya district to its north, Hassan district to its northwest and Bangalore district to its northeast.

The study area comprised of two taluks of Mysore district namely Hunsur and Heggadadevana kote. Hence these two were selected for the purpose of study because and leasing activity is hectic in these taluks, keeping in view the objectives of the study. Further from each taluk three villages were selected on the basis of area and leasing activity concerned. A sample consisting of 20 leased in ginger farms and another 20 owner cultivated ginger farmers at random in each taluk. Thus, making a total sample of 40 leased in farmers and 40 owner cultivated farmers. Overall sample size was 80.

3.1.2 Agriculture

The district covers a total geographical area of 6, 76,382 hectares of which 62,851 hectares constitutes the forest land. The net cultivable land is 4.86 lakh hectares and of this 1.14 lakh hectares of land is irrigated. The prominent river of the district is the Cauvery. Mysore district is considered as one of the prosperous district of the state based on the development and utilization of irrigation facilities, abundance of forest wealth and sericulture products. The climatic conditions of the district are favourable to grow a variety of crops like paddy, jowar, ragi, pulses, sugarcane and tobacco. The district can be divided into two major agro-climatic zones: the Southern Dry Zone comprising of 4 taluks, namely, Nanjangud, T. Narasipur, Mysore and K. R. Nagar and the Southern Transitional Zone consisting of H. D. Kote, Hunsur, and Periyapatna taluks. Soil is red sandy loam in most of the areas of the district. The annual rainfall ranges from 660 mm to 878 mm in dry zones and from about 610 mm to 1051 mm in the transitional zone. The average annual rainfall of the district is 802 mm. The temperature ranges from 11°C to 38°C. Thus, the climate of Mysore district is temperate with moderate variations in temperature in different seasons.

3.1.3 Demographic feature of the study area

The district has a population of 13.96 lakh with a density of 6337.45 people per sq.km and gender ratio of 967 females for 1000 males (2001 census), of which the rural population accounts for 60.71 per cent of the total and urban population constitutes 39.29 per cent of the total population. The district has seven taluks, 35 hoblies and the rural population lives in 1308 villages with 229 gram panchayats. The average literacy rate is around 64.29 per cent and the male and female literacy rate were 70 per cent and 55 per cent.

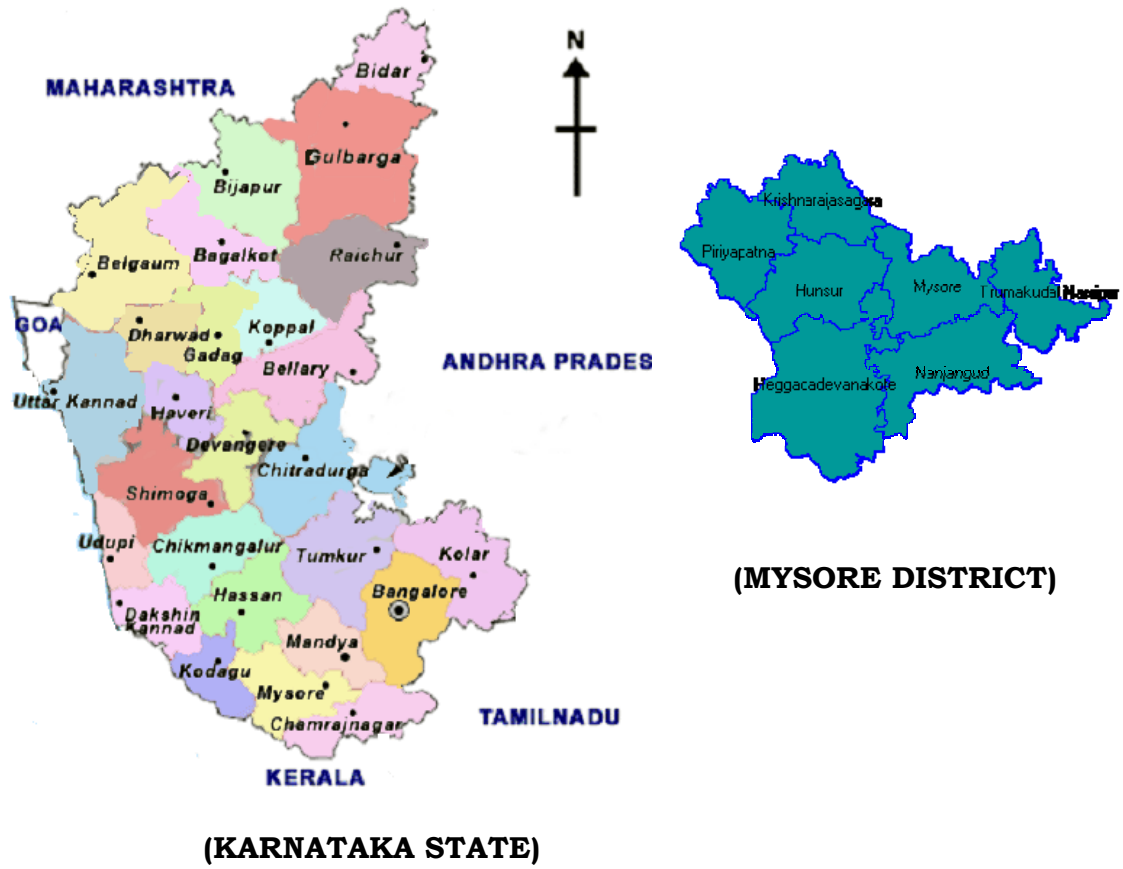


Fig 3.1 Map of the study area (Mysore District)

3.1.4 Climate, rainfall and soil type

There are three distinguishably different weather seasons in the district. The southwest monsoon spreads over from June to September, winter during the months of December to February and summer spreads over March to May.

The soils in the district fall mostly under red soils, black soils, sandy loam and of mixed type. The soils are shallow and sometimes deep. The soils lack drainage in some cases.

3.2 Sources of data and sampling design

Requisite data primary were collected by survey method using well structured interview schedule by personally contacting every sample farmers. Purposive cum random sampling was implied to collect the data. The farmers were explained the purpose of the study for ensuring their cooperation and reducing the bias entering into research. The data included the general characteristics of sample farmers, than land use pattern, land lease pattern, cropping pattern, farms inventory, live stock status, Costs and returns of ginger cultivation and constraints. Primary data pertaining to the crop year 2012-13 were collected from the selected farmers during the month of February 2013.

3.3 Analytical tools and techniques

3.3.1 Tabular presentation.

3.3.2 Production function analysis.

3.3.3 Sustainability analysis.

3.3.4 Garret ranking technique.

3.3.5 Concepts and terms used in the study.

3.3.1 Tabular presentation

Tabular analysis involving the computation of means, percentages etc. were employed to study the socio-economic characteristics, cropping pattern, cost and returns, resource use intensity and constraints expressed by the farmers.

3.3.2 Production function analysis.

3.3.2.1 Assessment of resource use efficiency in ginger cultivation

Regression analysis is a useful tool for analyzing factor productivity in any production activity including farming. Cobb-Douglas type of production function has been the most popular form of production function employed by researchers as it provides a compromise among (i) adequate fit to the data, (ii) computational simplicity and (iii) statistical testing. However, one of its serious limitations is that it accommodates either constant or increasing or decreasing marginal productivity and cannot depict an input-output curve embracing all the three relationships.

Despite the limitation, the function has the greatest application in diagnostic analysis as the regression parameters represent the elasticity's and reflects the marginal productivity of inputs at their geometric mean levels.

The specific Cobb-Douglas type of production function used for the study was;

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} U \quad \dots\dots\dots (1)$$

Where,

Y = Gross returns from owner cultivated ginger / leased-in ginger (Rs/farms)

a = Intercept, a scale parameter

X_1 = Rhizomes/ Planting material (quintals/farms)

X_2 = Farm yard manure (tonnes/farms)

X_3 = Chemical fertilizers (kgs/farms)

X_4 = Expenditure on plant protection chemicals (Rs/farms)

X_5 = Human labour (numbers/farms)

X_6 = Irrigation under owner cultivated ginger / leased-in ginger (acre inches)

U = Error term

b_i = Output elasticity's of respective inputs.

The equation (3) can be converted into linear form by taking logarithm on both sides. Ordinary least square (OLS) technique was adopted to estimate the equation.

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U \dots \dots (2)$$

Adjusted R^2 , the adjusted coefficient of multiple determinations were computed to test the goodness of fit of the model. The estimated values of regression coefficients were tested for statistical significance using 't' test with chosen level of significance.

3.3.3 Sustainability index

Sustainability in agriculture rests on the principle of meeting the present needs without compromising the ability of future generations to meet their own needs. Therefore, long-term stewardship of both natural and human resources is of equal importance to short-term economic gain. Stewardship of human resources includes consideration of social responsibilities such as working and living conditions of labourers, the needs of rural communities, and consumer health and safety both in the present and the future. Stewardship of land and natural resources involves maintaining or

enhancing the quality of these resources and using them in ways that allow them to be regenerated for the future.

3.3.3.1 Details of sustainable indicators

To analyse the sustainability in ginger cultivation under leased in and owned land condition, ten indicators of sustainability were chosen. The chosen indicators are land, seeds, farms yard manure, fertilizers, plant protection chemicals, labour, share of chemical pesticides, share of chemical fertilizers, share of ecologically undestructive inputs in and share of purchased inputs in the total cost of cultivation.

The six sustainable indicators such as land, seed, labour, fertilizer, plant protection chemicals, and farms yard manure are having different units of measurement. These indicators are made unit free by converting the actual input/s use into unit values U_{ik} 's using appropriate conversion. The conversion factor for these indicators is given below,

$$U_{ik} = \frac{Y_{ik} - \text{Min } Y_i}{\text{Max } Y_i - \text{Min } Y_i} \dots\dots\dots(1)$$

Where,

U_{ik} is the unit value of the i^{th} indicator (actual input use) for the k^{th} farmer

Y_{ik} is the value of the i^{th} indicator for the k^{th} farmer

$\text{Max } Y_i$ is the maximum value of the i^{th} indicator among the sample farmers

$\text{Min } Y_i$ is the minimum value of the i^{th} indicator among the sample farmers.

The unit values (U_{ik} 's) are devoid of unit of measurement and ranges from 0 to 1. When Y_{ik} is maximum (actual input used by the i^{th}

farmer), unit value will be 1 and when Y_{ik} is minimum, unit value will be 0. Since for these factors/ indicators, high value for the input use is desirable.

For the other sustainable indicators i.e. share of chemical pesticides, share of chemical fertilizers, share of ecologically un destructive inputs and share of purchased inputs in the total cost of cultivation, low values are desirable, hence the conversion factor can be written as,

$$U_{ik} = \frac{\text{Max } y_i - Y_{ik}}{\text{Max } Y_i - \text{Min } Y_i} \dots\dots\dots (2)$$

Here also the unit values range from 0 to 1. When Y_{ik} is minimum, unit value will be 1 and when Y_{ik} is maximum, unit value will be 0.

3.3.3.2 Assigning relative weights to sustainability indicators

Ten experts from various disciplines concerning to sustainable issues in agriculture such as soil scientist, agricultural entomologist, agricultural pathologist, economist were asked to rank these indicators in their descending order of importance. For this ranked set, the weights for different indicators were computed using Garret’s ranking technique (Garret, 1952). The ranks assigned were transformed into percentage scores using the formula.

$$\text{Percentage score} = \frac{(R_{ij} - 0.5)}{N_j} \times 100 \dots\dots\dots (3)$$

Where,

R_{ij} is the rank given for i^{th} indicator by the j^{th} expert

N_j is the number of indicators ranked by the j^{th} expert

Average score was derived for each indicator and was termed as scale value (S_i) of each indicator.

3.3.3.3 Developing the sustainability index

Sustainability index was then formulated for both leased in and land owned ginger farmers by computing the weighted average of the unit values (U_{ik}) with their respective scores (S_i) as weights. Thus, the sustainability index of the kth farmer is calculated as,

$$SI_k = \frac{\sum_{k=1}^n (U_{ik} \times S_i)}{\sum_{i=1}^8 S_i} \dots\dots\dots (4)$$

Where, SI_k is the sustainability index of the kth farmer

U_{ik} is the unit value of the ith indicator for the kth farmer

S_i is the scale value of the ith indicator.

The mean value of the sustainability index was computed to indicate the sustainability status of production system followed by the ginger growers under both the condition. Higher the value of sustainability index (close to 1) reflects higher sustainability.

Classification of sample farmers based on sustainability index

The significant difference between the mean sustainability indices of leased in and owner cultivated farms were tested using t-test.

$$t = \frac{(\bar{x}_1) - (\bar{x}_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \dots\dots\dots (5)$$

Where, \bar{x}_1 = Mean of sample 1

\bar{x}_2 = Mean of sample 2

σ_1^2 = variance of sample 1

σ_2^2 = variance of sample 2

n_1 = number of observations in sample 1

n_2 = number of observations in sample 2.

Classification of sample farmers based on the deviation of their sustainability index from the mean value as follows:

Farmers having sustainability index (SI) of less than Mean SI - $\frac{1}{2}$ SD were classified as low sustainable ginger growers. Those having SI between Mean SI - $\frac{1}{2}$ SD and Mean SI + $\frac{1}{2}$ SD were classified as moderately sustainable and those having sustainability index more than Mean SI + $\frac{1}{2}$ SD were classified as highly sustainable ginger growers.

3.3.4 Garrett's ranking technique:

To analyze the production constraints in cultivation of ginger, Garrett's ranking technique was employed. The major advantage of this technique as compared to simple frequency distribution is that the constraints are arranged based on their importance from the point of view of farmers. Hence the same number of farmers on two or more constraints may have been given different rank Kumar *et al* (1999).

Garrett's formula for converting ranks into per cent was given by

$$\text{Per cent position} = 100 * (R_{ij} - 0.5) / N_j \dots \dots \dots (6)$$

Where, R_{ij} = rank given for i^{th} factor by j^{th} individual.

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

The per cent position of each rank then converted into scores referring to the table given by Garret and Woodsworth (1969). For each factor, the scores of individual farmers were added together and divided by the total number of the farmers for whom scores were

added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified.

3.3.5 Concepts and terms used in the study

The cost of cultivation of ginger is under two heads namely variable and fixed costs.

- a) **Variable costs:** Variable costs included cost of seeds, manure, fertilizers, wages of human and machinery labour, plant protection chemicals, interest on working capital and repairing and maintenance.
 - b) **Rhizomes:** Rhizomes valued at actual price paid by the sample farmers.
 - c) **Farms yard manure:** The prevailing price of FYM was used to impute the value of farm yard manure used in ginger cultivation.
- i. **Fertilizers and plant protection chemicals:** The cost of fertilizers and plant protection chemicals were valued at the rates including the cost of transportation and other incidental charges, if any.
 - ii. **Labour:** The cost of hired labour was calculated at the prevailing wage rates paid per day (8 hours) in the study area for Men (200 Rs./day), Women (150 Rs./day) and Machine labour (600 Rs./hr). The cost of family labour, animal and machinery was calculated at the prevailing wages in the study region through imputation.
 - iii. **Interest on operational capital:** Interest on working capital consisting of the expenditure on labour, seeds, farms yard manure, fertilizers and plant protection chemicals, and materials was calculated at 7 per cent per annum (the rate

charged by commercial banks for short term or crop loans) for one year considered as duration of the crop.

iv. Repairs and maintenance charges: Repair and maintenance charges of implements and machinery used in the ginger cultivation were computed on the basis of actual expenses incurred by the farmers. The amount was apportioned to different crops based on the percentage area under crops.

a. Fixed costs: These include depreciation of farms building, implements and machinery, interest on fixed capital, land revenue and land rent.

The definitions and concepts of fixed costs incurred in ginger cultivation is given as follows.

Depreciation: Depreciation on each capital asset owned and used by the farmers for ginger cultivation was computed using the straight line method.

Annual depreciation = Purchase value – Junk value

Economic life of the asset

Information on economic life of the asset was collected from the experts of department of Agricultural Engineering, Agriculture College GKVK, Bangalore and used in the present study. The depreciation of each equipment was apportioned based on percentage area under each crop.

i. Interest on fixed capital: Interest charges on fixed capital were calculated at the rate of 9 per cent offered by commercial banks on fixed deposits. Interest was computed on the present value of the assets and charged to crop on the basis of area under the crop.

ii. Land revenue: Actual land revenue paid by the farmers was considered.

iii. Rental value of land: Rent is estimated on the basis of the amount paid by those farmers who leased in land for ginger cultivation.

b. Cost of cultivation: It was the sum total of variable and fixed costs per acre.

3.5.5.2 Returns:

Gross returns: Gross returns were obtained by multiplying the total product on price realized.

Net returns: Net returns were obtained by deducting the total costs from the gross returns.

Benefit cost ratio: it was computed by dividing the gross returns by total cost.

IV. RESULTS

The results of the present study are presented in this chapter under the following headings

- 4.1 Socio-economic characteristics of sample farmers.
- 4.2 Land use and leasing pattern of sample farmers.
- 4.3 Cost and returns of owner cultivated and leased-in ginger farms.
- 4.4 Resource use intensity in ginger cultivation.
- 4.5 Production function analysis.
- 4.6 Sustainability of owner cultivated and leased-in ginger farms.
- 4.7 Constraints in cultivation of ginger.

4.1 Socio-economic characteristics of sample farmers

The details pertaining to socio-economic characteristics are presented in Table 4.1. Socio-economic characteristics includes age, education level, family size, farms size, income and percentage of area under ginger cultivation. It is evident from the table that mean age of the sample farmers for owner cultivated ginger farms was 43 years and 44 years for leased-in ginger farms. With regard to education it was observed that 18 farmers (45 per cent) out of 40 were illiterates in case of owner cultivated ginger farms. While 16 (40 per cent) out of 40 were illiterates in case of leased-in ginger farms. It is important to note that only few farmers numbering 2 (5 per cent) and 3 (7.5 per cent) had studied up to college level in case of owner cultivated and leased-in ginger farms respectively. The maximum number of farmers had primary education in both the cases. The average size of family was 7 and 6 persons respectively. The farmers of leased-in had an average farms size of 14.2 acres when compare to 6.35 acres of owner cultivated farms. The average annual income of leased-in farms was higher (Rs.281395) than owner cultivated farms (Rs.127976). Owner

Table 4.1: Socio-economic characteristics of sample farmers

	Particulars	Owner cultivated ginger Farms	Leased-in ginger farms
		No of farmers (n=40)	No of farmers (n=40)
1	Age (mean)	43	44
2	Education level		
	Illiterate	18 (45.0)	16 (40.0)
	Primary	15 (37.5)	14 (35.0)
	High school	5 (12.5)	7 (17.5)
	College	2 (5.0)	3 (7.5)
	Total	40 (100)	40 (100)
3	Family size	7	6
4	Farms size	6.35	14.20
5	Average Income	1,27,976	2,81,395
6	Percentage of farms under ginger	40.99	59.01

Note: Figures in parentheses represent percentage to the respective sample size.

cultivated farms had allocated 41 per cent of their land holding for ginger cultivation.

The leased-in ginger farms had spared 59 per cent of the land holding for ginger alone.

4.2 Land use and land leasing pattern of sample farmers.

4.2.1 Cropping pattern of sample farmers

Particulars relating to the cropping pattern are depicted in the Table 4.2. Careful examination of the table revealed that the cropping pattern on owner cultivated farms as well as leased-in ginger farms was dominated by tobacco crop during kharif season. The other crops grown during kharif season included maize, cotton and ragi. During rabi season pulse crops were cultivated. But during summer ginger crop was cultivated on both owner cultivated and leased-in farms. As much as 40 per cent and 59 per cent of the total land holding on both the situations was devoted for ginger crop. Ginger was grown under irrigation condition.

4.2.2 Leasing activity

4.2.2.1 Category wise land leasing pattern among owner cultivated ginger farms.

Table 4.3 portrays the land leasing activity among the owner cultivated ginger farms. It is evident from the table that marginal farmers leased out 75 per cent of their total land holding followed by 58 per cent by small farmers, 43 per cent by medium farmers and 36 per cent by large farmers. The area owned by large farmers was 20.90 acres out of which land leased out was 7.7 acres. The small farmers constituting 17.5 per cent of the sample size owned on an average 3.85 acres leased out 2.25 acres accounting for 58 per cent of their land holding. The medium farmers numbering 12 in the sample size formed 30 per cent had on an average 8.8 acres of land holding. Of this 3.8 acres was leased out.

Table 4.2: Cropping pattern of the sample farms.

SI no.	Season/ Crop	Rainfed/ irrigated	Area per farms in owner cultivated crops per farm (n=40)	Area per farms in lease cultivated crops per farm (n=40)
I.Kharif				
1	Tobacco	Rainfed	2.20 (24.31)	2.40 (15.17)
2	Maize	Rainfed	0.76 (8.39)	1.20 (7.58)
3	Cotton	Rainfed	0.75 (8.39)	1.05 (6.63)
4	Ragi	Rainfed	0.60 (8.28)	0.80 (5.05)
II.Rabi				
1	Field Bean	Rainfed	0.30 (3.64)	0.35 (2.08)
2	Horse gram	Rainfed	0.13 (3.31)	0.13 (2.21)
3.	Green gram	Rainfed	0.33 (1.43)	0.33 (0.82)
4.	Cowpea	Rainfed	0.12 (1.32)	0.21 (1.32)
III.Summer				
1	Ginger	Irrigation	3.70 (40.9)	9.35 (59.10)
		Gross cropped area	8.89(100)	15.82 (100)

Note: Figures in parentheses represent percentage to the respective sample size.

Table 4.3: Category wise land leasing pattern among owner cultivated ginger farms.

Particulars	Number	Average area owned (acre)	Average area leased-out (acre)	Percentage area under leased-out
Marginal farmers	2 (5)	2.00	1.50	75
Small farmers	7 (17.5)	3.85	2.25	58
Medium farmers	12 (30)	8.80	3.80	43
Large farmers	19 (47.5)	20.90	7.70	36
Total	40 (100)			

Note: Figures in parentheses represent percentage to the respective sample size.

4.2.2.2 Category wise land leasing pattern among leased-in ginger farms.

Table 4.4 portrays the land leasing activity among the leased-in ginger farms. It is evident from the table that majority of the farmers who leased-in lands were large farmers (47.5 %) followed by medium farmers (27.5 %), small farmers (20 %) and (5 %) marginal framers. The average area owned by large farmers worked out to 12.84 acres. In addition to this they leased-in 11.5 acres exclusively for ginger cultivation which constituted 47.24 per cent of the total operational holding of 24.34 acres (owned + leased-in). The medium farmers who were 11 number in the sample size owned on an average 8.10 acres of land. They leased in 6 acres of land from others for cultivation of ginger crops thus making 14.10 acres as their operational holding. The small farmers owned 4 acres on leased in 2.5 acres for ginger cultivation their operational holding thus worked out to 6.5 acres constituting 38.40 per cent. Similarly the marginal farmers had leased-in 0.75 acres of land to cultivate ginger which constituted 25 per cent of their operational holding.

4.2.2.3 Land rentals in the study area.

The Table 4.5 shows the details pertaining to rentals value of land for different crops in the study area. It could be observed that farmers lease out their land to ginger cultivation at the rate of Rs. 27, 800 per acre, followed by tobacco cultivation with the rental value of Rs. 10000 per care. Some farmers opted to lease out their land to cultivate maize and cotton crops at the rate of Rs.8000 and Rs.7000 per acre respectively.

4.3 Cost and returns of owner cultivated ginger and leased-in ginger farms

4.3.1 Cost of cultivation of ginger on owner cultivated farms.

Table 4.6 portrays the details pertaining to cost of cultivation of ginger per acre fewer than 3 broad categories namely material costs,

Table 4.4: Category wise land leasing pattern among leased-in ginger farms.

Particulars	Number	Average area owned (acre)	Average area leased-in (acre)	Percentage area under leased-in
Marginal farmers	2 (5)	2.25	0.75	25.00
Small farmers	8 (20)	4.00	2.50	38.40
Medium farmers	11 (27.5)	8.10	6.00	42.50
Large farmers	19 (47.5)	12.84	11.50	47.24
Total	40 (100)			

Note: Figures in parentheses represent percentage to the respective sample size.

Table 4.5: Prevailing Rental value of land in the study area.

SI.NO	Crops	Rental value of land (Rs/acre)
1	Ginger	27800
2	Tobacco	10000
3	Maize	8000
4	Cotton	7000

Table: 4.6 Cost of cultivation of Owner cultivated ginger farms.**(Per acre)**

I.	Operational cost	Quantity	Cost (Rs)
1	Human labour (no's)	183	36600
2	Machine labour (hrs)	5	3000
3	Rhizome (q)	12.72	38180
4	Farmyard manure (tons)	7.85	11464
5	Chemical fertilizers (kgs)	445	9078
6	Plant protection chemicals (l)	120	7921
7	Irrigation cost (acre inches)	35	8978
8	Electricity charges (Rs)		270
9	Interest on working capital at 7% per annum		4042
	Total operational cost		1,19,533
II.	Fixed cost		
1	Depreciation		1513
2	Land revenue		5
3	Rental value of owned land		27800
4	Interest on fixed capital at 9% per annum		6696
	Total fixed costs		36,014
	Total cost		1,55,547

cost of labour and fixed costs. It is evident from the table that Rs. 1, 55,547 is required to cultivate one acre of ginger. Of this, variable cost inclusive of material cost plus labor cost accounted for 74 per cent of total cost. Rhizomes, farms yard manure, fertilizers were the major expenditure incurred with Rs.38, 180, Rs.11, 464 and Rs. 9,078 constituting 32 per cent, 11 per cent and 7 per cent of the total cost of cultivation respectively. Expenditure on plant protection chemicals was Rs. 7921. Cost of labour was Rs 36,600. About 183 man days of labour was required to cultivate one acre of ginger. Weeding was the most labour intensive operation requires 96 man day of labour costing Rs. 19, 200 followed by application of FYM, neem cake and thimmet requires 34 man days. Planting of rhizome application requires an expenditure of Rs.3400. Mulching is another operation in ginger cultivation which requires an average of 8 man days of labour. The fixed cost included depreciation, land rent, land revenue and interest on fixed capital which together constituted 24 per cent of total cost.

4.3.2 Cost of cultivation of ginger on leased-in operated farms.

Table 4.7 provides information on cost of cultivation of ginger on leased-in farms. The per acre total cost of cultivation was Rs. 1, 81,630. This included material cost of Rs.98, 795, Labour cost of Rs.39, 600 and fixed cost of Rs.36, 820. Among the material costs, rhizome cost alone accounted for lion share with 47 per cent of the total cost. Closely followed by land rent about Rs. 27,800 (14 %), FYM worth Rs. 16,651 (8 %) in the total cost. The cost of fertilizer constituted 6 per cent of the total cost. The expenditure on plant protection chemicals was Rs.12, 202. The labor cost was worked out to Rs.39, 600. The plant protection chemicals application needed an expenditure of Rs. 12,200 followed by fertilizer application (Rs. 11,121). Weeding was the most expensive operation requires Rs. 21, 200 (12 %) constituting in cost of labour. The total variable cost inclusive of material cost and labor cost came to Rs.1, 38,395

Table 4.7: Cost of cultivation of ginger on leased-in operated farms.

(Per
acre)

I.	Operational cost	Quantity	Cost (Rs)
1	Human labour (no's)	198	39600
2	Machine labour (hrs)	5	3000
3	Rhizome (q)	14.3	46321
4	Farmyard manure (tons)	7.85	16651
5	Chemical fertilizers (q)	445	11121
6	Plant protection chemicals (l)	120	12202
7	Irrigation cost (acre inches)	35	9200
8	Electricity charges (Rs)		305
9	Depreciation		1513
10	Interest on working capital at 7% per annum		4897
	Total operational cost		1,44,810
II.	Fixed cost		
1	Rental value of owned land		27800
2	Interest on fixed capital at 9% per annum		9020
	Total fixed costs		36,820
	Total cost		1,81,630

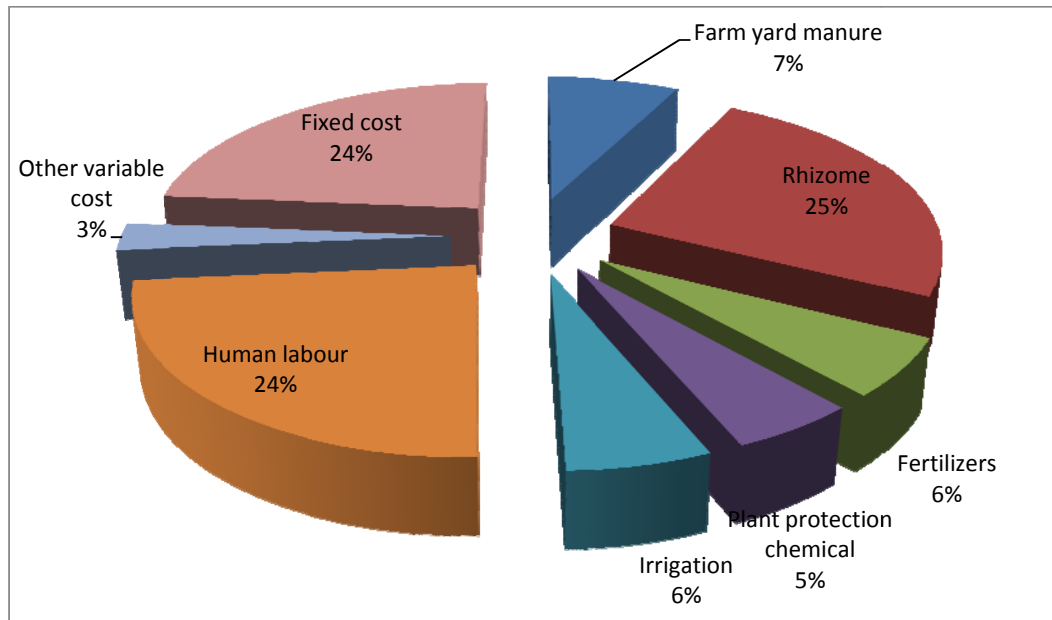


Fig. 4.1: Share of different inputs to the total cost of cultivation of Owner cultivated ginger crop.

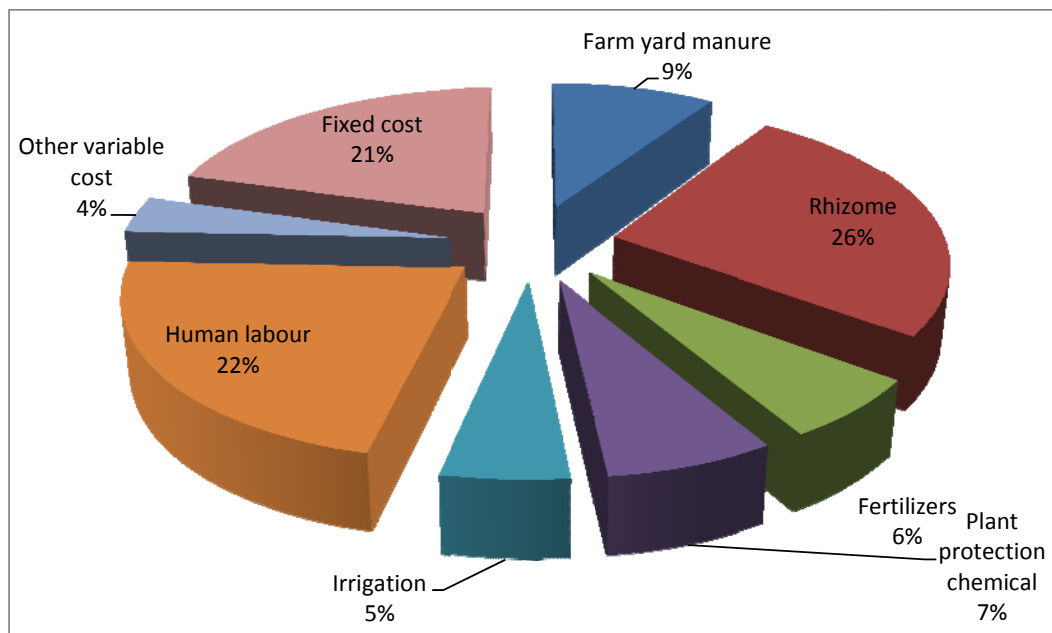


Fig. 4.2: Share of different inputs to the total cost of cultivation of leased-in operated ginger crop.

constituting 79 per cent of total cost. The fixed cost comprising of land rent, land revenue, depreciation and interest rate on fixed capital to the Rs.36, 820 accounting for 20 per cent to the total cost.

4.3.3 Yields and returns of ginger.

The details of returns from ginger cultivation is presented in the Table 4.8. It was observed that the yield realized on leased-in ginger farms was higher at 102 quintals as compared to owner cultivated farms at 87 quintals. The owner cultivated farms realized gross return of Rs. 2,62,756 at an average price of Rs. 3,034 per quintal while the leased-in ginger farms also realized an average price of Rs. 3, 034 per quintal of ginger and realized gross returns of Rs. 3, 09,468. Therefore the owner cultivated farms obtained net income of Rs. 1, 07,209. The leased-in ginger farms obtained slightly higher net returns of Rs. 1, 27,838. The Benefit cost ratio was 1.68 and 1.70 respectively on owner cultivated farms and leased-in farms respectively.

4.4 Resource use intensity in ginger cultivation

In case of both owners' operated and leased-in ginger cultivation the farmers used higher dosage of inputs than the recommended dosage. But the deviation from the recommended dosage was highest in case of leased-in ginger farms compared to owner cultivated ginger farms. In this case farmers used 173 per cent of fertilizer more than the recommended dosage. Whereas in case of owner cultivated farmers were used 122.5 per cent of fertilizer more than the recommended dosage. Application of planting materials as well as plant protection chemicals were also found to be used more than the recommended dosages in both the cases whereas in case of application of farm yard manure the farmers were using less than the recommended dosage in both the cases.

4.5 Regression analysis

The Table 4.10 indicates per farms gross returns from owner cultivated ginger and leased-in ginger during the crop year 2012-13

Table 4.8: Yield and Returns from owner cultivated ginger and leased-in ginger cultivation.

(Rs/acre

Sl. No	Particulars	Owner cultivated ginger	Leased-in ginger
1	Yield (quintals)	87	102
2	Price (Rs/qt)	3034.00	3034.00
3	Total cost (Rs)	1,55,547.00	1,81,630.00
4	Gross returns (Rs.)	2,62,756.00	3,09,468.00
5	Net returns (Rs.)	1,07,209.00	1,27,838.00
6	Returns per rupee of expenditure	1.68	1.70

)

Table 4.9: Input use pattern in Owner cultivated and leased-in ginger farms.

(Per acre)

Particulars	Recommended dosage	Owner cultivated ginger farms		Leased-in ginger farms	
		Actual	Deviation (%)	Actual	Deviation (%)
Rhizomes (Qt)	6	12.73	112.00	14.30	138.00
FYM(tons)	10	7.85	-21.5	8.90	-11
Fertilizers (kgs)					
N	100	197.00	97.00	258.50	158.50
P	50	136.00	172.00	153.00	206.00
K	50	112.00	124.00	134.50	169.00
Total/Average	200	445.00	122.50	546.00	173.00
PPC (lit)	115	120	4.34	128	11.30

which was regressed to identify the contribution of factors like rhizomes, farms yard manure, plant protection chemicals and human and machine labour. The regressions estimates of the both owner cultivated and leased-in ginger farming are presented in Table 4.10.

The co-efficient of determination (R^2) was 0.52 and 0.57 for owner cultivated and leased-in ginger farming respectively but the model was statistically significant as reflected in 'F' statistics (9.32) at 5 per cent of level of significance, indicating adequate fit of the model as nearly 52 and 57 per cent variability in gross returns was explained by the variables considered in the model. The intercept, which represents the contribution of the factors that are not included in the model, was found to be higher in the case of leased-in ginger farmer's field (4.93) compared to owner cultivated ginger farming (6.58). The regression co-efficient of rhizome (0.092) in the owner cultivated ginger farming was significant at 5 per cent confidence level and of rhizome (0.428) were found to be significant at 5 per cent confidence level. While that of fertilizers (0.316) of owner cultivated ginger farming and (0.026) of leased-in ginger farming were significant at 1 and 5 per cent confident level respectively. While that of plant protection chemicals of leased-in ginger farms was significant at 5 per cent confidence interval. The regression co-efficient of irrigation (0.141) and (0.133) was significant at 1 per cent confidence level while that of other factors were not statistically significant.

The other co-efficient i.e., farms yard manure and labour in both owner cultivated and leased-in ginger were not significant and also the regression co-efficient of plant protection chemicals (0.05) with respect to owner cultivated ginger was not significant.

4.5.1 MVP to MFC ratio of owner cultivated ginger and leased-in ginger farming.

Allocative efficiency is the ratio of marginal value product to marginal factor cost. Table 4.11 revealed that the allocative efficiency

Table 4.10: Regression co-efficient of owner cultivated and leased-in ginger farming.

Sl. No.	Variables	Regression Co-efficient	
		Owner cultivated ginger farms	Leased-in ginger farms
1	Intercept	4.83	4.97
2	Rhizome (qtl)	0.092** (0.047)	0.428* (0.014)
3	Farms Yard Manure (tons)	0.004 (0.948)	0.023 (0.747)
4	Fertilizers (kgs)	0.316* (0.001)	0.026** (0.021)
5	Plant Protection Chemicals (Rs)	0.055 (0.679)	0.389** (0.021)
6	Labour (No's)	0.012 (0.932)	0.344 (0.493)
7	Irrigation(Rs)	0.141* (0.005)	0.133* (0.014)
	R ²	0.52	0.57
	F ratio	4.012 (0.005)	2.640 (0.04)

Note: Figures in the parentheses indicate 'P-value' of the regression co-efficient.

* Significant at 1 per cent

** Significant at 5 per cent

of resources used in both owners operated and leased-in ginger farms are furnished in the Table. 4.10. The ratio of MVP to MFC for rhizomes, farms yard manures, fertilizer, labor, plant protection chemicals and irrigation were 0.61, 0.57, 0.45, 0.45, 0.90, 0.63 respectively in case of owner cultivated ginger farms and in case of leased-in ginger farms the ratios were 0.74, 0.02, 0.01, 0.32, 0.43, 0.15 respectively.

4.6 Sustainability at farms level

Ten sustainability indicators were selected for assessing sustainability status of the owner cultivated and leased-in ginger production systems and indexing approach was followed to construct the sustainability index.

4.6.1 Sustainability indicators and their ranks

The ten sustainability indicators as presented in Table 4.12 were ranked by ten experts from different faculties of agricultural sciences and Garret ranking technique was used to assign relative weights for each of these indicators. The scale value for each indicator and their respective ranks are presented in table 4.12. The indicator which is ranked a prime importance was farm yard manure in case of owner cultivated ginger farms with the highest scale value of 95.42 followed by rhizome, land, fertilizer, labor and plant protection chemicals. The ratio of commercial fertilizers to the total cost of cultivation occupied seventh rank followed by the ratio of chemical fertilizers to total cost of cultivation, the ratio of commercial pesticides and purchased to total cost of cultivation occupied eighth and ninth respectively. Ratio of ecological non destructive inputs to the total cost of cultivation with the lowest scale value of 20.47 was ranked last.

In case of leased-in ginger cultivation farm yard manure was ranked first with the highest scale value of 98.10 followed by rhizome, fertilizers, plant protection chemicals, labour, land, ratio of

Table 4.11: Allocative efficiency of owner cultivated ginger and leased-in ginger farming.

Variables	Owner cultivated ginger	Leased-in ginger
Rhizome	0.61	0.74
FYM	0.57	0.02
Fertilizer	0.45	0.03
Labour	0.45	0.32
PPC	0.90	0.43
Irrigation	0.63	0.15

commercial pesticides fertilizers to total cost of cultivation, ratio of cost of chemical fertilizers to total cost of cultivation, ratio of purchased inputs to total cost and ratio of ecological non destructive inputs to total cost with the least rank value of 16.74.

4.6.2 Sustainability index of owner cultivated ginger and leased-in ginger farms.

The weighted averages of ten sustainability indicators were worked out to represent the composite sustainability index separately for each farm. The mean composite sustainability indices of owner cultivated and leased-in farming are presented in Table 4.13. It could be observed from the table that the mean sustainability index of owner cultivated ginger farms was 0.26 whereas it was 0.28 in case of leased-in ginger farms. The difference between the two mean sustainability indices was found to be non significant. The co-efficient of variation of sustainability index in case of owner cultivated ginger was 30.76 per cent as against 18.40 in leased-in ginger farms. The t-statistic was found to be non significant.

4.6.3 Classification of sample farmers according to the sustainability index in case of owner cultivated ginger and leased-in ginger farming.

The two different categories of farmer's *viz.*, owner cultivated farmers and leased-in ginger farmers were classified into three sustainability group's *viz.*, low, medium and high, based on their sustainability index and the results are presented in Table 4.14. It could be observed that 32.5 per cent of owner cultivated ginger farms and 30 per cent of leased-in farms were in low sustainability group. Further it was noticed that 45 per cent of leased-in ginger farms and 42.5 per cent of the owner cultivated ginger farms were in medium sustainability group. About 25 per cent of the owner cultivated ginger farms and leased-in ginger found place in high sustainability group.

Table 4.12: Ranking of sustainability indicators of owner cultivated ginger and leased-in ginger farms.

SL. NO.	INDICATORS	Owner cultivated ginger farm		Leased-in ginger farm	
		Scale Value	Ranks	Scale Value	Ranks
1	Land	74.34	III	37.07	V
2	Rhizome	87.31	II	90.53	II
3	Farm Yard Manure	95.42	I	98.10	I
4	Fertilizer	72.28	IV	70.40	III
5	Plant protection chemicals	43.04	VI	61.09	IV
6	Labour	68.35	V	40.77	V
7	Ratio of ecologically non destructive inputs to total cost	20.47	X	16.74	X
8	Ratio of chemical fertilizers to total cost	37.10	VIII	34.19	VII
9	Ratio of commercial pesticides to total cost	39.47	VII	37.90	VIII
10	Ratio of purchased inputs to total cost	25.79	IX	24.02	IX

Table 4.13: Sustainability index of owner cultivated ginger and leased- in ginger farms.

Particulars	Mean	Variance	SD	CV	Observations	t-statistic
Owner cultivated ginger farms	0.26	0.0067	0.082	30.76	40	-1.05
Leased-in ginger farms	0.28	0.0027	0.052	18.40	40	

Note: No Significant, SD: Standard Deviation, CV: Coefficient of Variation

Table 4.14: Classification of sample farmers according to the Sustainability index.

GROUPS	Category of Farmers		Total number of farmers in each group
	Owner Cultivated ginger Farmers	Leased-in ginger Farmers	
Low sustainability group	13 (32.5)	12 (30)	25
Medium sustainability group	17 (42.5)	18 (45)	45
High sustainability group	10 (25)	10 (25)	20
Sample size	40	40	80

Note: Figures in parentheses represent percentage to the respective sample size

4.7 Constraints faced by sample ginger farmers.

The opinion of respondents on production constraints was elicited from the sample farmers and subjected to Garret's ranking technique.

Major constraints experienced by ginger farmers (Table 4.15) were high disease incidence, high cost of rhizome, high cost of input, pest occurrence, non availability of varieties, non availability of quality rhizome and low output.

The results of the Garret ranking technique is presented in the Table 4.15. The opinion of respondents revealed that incidence of diseases was the major constraint in ginger cultivation. Followed by high cost of rhizome, higher cost of input (III rank), pest occurrence (IV rank), non availability of varieties (v rank), non availability of quality seed material (VI rank) and low output were the other constraints as opinioned by sample farmers.

Table 4.15: Constraints faced by sample ginger growers.

Sl. No.	Particulars	Garret score	Rank
1	Disease occurrence	71.1	I
2	High rhizome cost	67.2	II
3	High input cost	66.3	III
4	Pest occurrence	43.6	IV
5	Non availability of variety	40.9	V
6	Non availability of quality rhizome	38.0	VI
7	Low yield	27.0	VII

V. DISCUSSION

The results of the study presented in the previous chapter are discussed in this chapter under the following heads:

- 5.1 Socio-economic characteristics of sample farmers.
- 5.2 Land use and leasing pattern of sample farmers.
- 5.3 Cropping pattern of sample farmers.
- 5.4 Cost of cultivation of owner cultivated ginger and leased-in ginger farms.
- 5.5 Yields and returns of owner cultivated ginger and leased-in ginger farms.
- 5.6 Input use intensity.
- 5.7 Sustainability of ginger cultivation.
- 5.8 Constraints in cultivation of ginger.

5.1 Socio-economic characteristics of sample farmers

Age is the important socio economic characteristics which influences the decision making process of sample farmers. The average age of farmers in case of owner cultivated and leased-in farms ranged from 43 to 44 years indicating that the sample farmers were in their prime age group (middle age group) with sufficient mental maturity. Educational status is another factor which influences the mindset in day to day farms decision making. Majority of farmers were illiterates. About 37.5 per cent of the respondent farmers had completed their primary education and only few could complete secondary and college education. This indicated poor educational status of respondent's farmer. Majority of sample farmers in both the situations had dropped out of school either at pre-primary or primary levels to support their parents in agriculture. The family size of sample farmers did not exhibit much variation between the owner cultivated and leased-in ginger farms. The size of family was almost found to be

on par with 7 and 6 members per family in case of owner cultivated ginger and leased-in ginger farms. With regard to farms size the size of the land holding was 6.35 acres and 14.2 acres in case of owner cultivated ginger and leased-in ginger farms. The owner cultivated ginger farms are medium and leased-in ginger farmers are having larger holdings. The farmers from neighboring Kerala state have migrated to Hunsur and H.D. Kote taluk and have taken up farming as a main profession. Being land less they have decided to take land on lease basis to cultivate ginger which is highly remunerative. Incidentally the local farmers are also prepared to lease out the portion of their land holdings to the Keralites in a bid to earn ready cash income. It was also revealed that leased-in ginger farmers are financially better off as compared to owner cultivated ginger farms. The percentage of area under ginger crop was only 40 per cent of the total land holding in case of owner cultivated ginger farms as against 59 per cent in case leased-in ginger farms. The farmers migrated from neighboring states are financially sound and are able to increase area under ginger cultivation by taking more land from local farmers on lease basis. The result of the study supported by similar findings of Shafiqul islam *et al* (2012). Farmer's education and experience in ginger cultivation was less.

5.2 Land use and leasing pattern of sample farmers.

Owner cultivated ginger farms

Land leasing activity has been existing in the study area for over two decades. Leasing out of land was done for ginger cultivation and is being practiced by marginal farmers, small farmers, medium farmers and large farmers to an extent of 75, 58, 43 and 36 per cents respectively. Ginger being highly capital intensive crop requires huge investment of over 1.5 lakhs, it is beyond the means of small and marginal farmers to cultivate on their own. Hence, they have resorted to the strategy of land leasing activity on large scale. The small

farmers who lack their own financial resources have adopted this strategy in a significant manner. The large farmers, though capable of cultivating their land holdings on their own, unable to do so have leased-out portion of their land holdings as they have excess land resources.

Leased-in ginger farms

It is also observed in the table that marginal farmers, small farmers, medium farmers and large farmers have taken land on lease exclusively for cultivation of ginger to an extent of 25 per cent (0.75 acres), 38.4 per cent (2.5 acres), 42.5 per cent (6 acres) and 47.24 percent (11.5 acres) respectively. The marginal farmers having no means to pay higher land rents could not afford to lease-in land for ginger. However the large farmers who were financially sound and willing to cultivate ginger have taken substantial area (11.5 acres) on lease basis.

5.2.1 Prevailing rental value of leased-in land.

Fixed rentals involve a cash payment paid in advance to the land lord. The lessee cultivators cultivate ginger incurring expenditure on ginger cultivation. They reap all the benefits and bear all the risk in production of ginger. The land owner is not in way related to the lessee. The agreement between the two is for one year and a written agreement is used in most of the cases. The average rental was Rs. 27800. The land rent is quite high since the crop of ginger is a high value crop.

5.3 Cropping pattern of sample farmers.

As could be seen in Table 4.2, the land use pattern reflected crop diversity ranging from commercial crops like tobacco and cotton during kharif season, pulses during rabi and ginger during summer. The land use pattern is like a mirror of farms reflecting different sources of income for the farmer. Ginger is largely grown in the area

as an important commercial crop bringing higher cash income to the cultivators. Moreover the climate and soil are conducive for ginger cultivation. Cultivation of food crops like ragi, paddy was not given prominence in the region. The farmers are more inclined to cultivate such of those crops which would fetch higher cash income.

5.4 Cost of cultivation of owner cultivated ginger and leased-in ginger farms.

Cost of cultivation of ginger was worked out taking into consideration the current input and output prices. The cost of cultivation of ginger was relatively lower in case of owner cultivated ginger farms. This was mainly due to reduction in input use. The cost of cultivation of ginger was higher in case of leased-in ginger farms which are due to increased use of inputs. On an average cost of cultivation per acre worked out to Rs. 1, 55,547 in case of owner cultivated ginger farms. While Rs. 1, 81,830 in case of leased-in ginger farms. Among the paid out cost, the cost of rhizome was highest in case of owner cultivated ginger farms which may be ascribed to lesser rhizome rate (seed rate) used by them. The leased in farmers have been using higher quantity of seed material as compared to their counter parts under the belief that they will be able to get better output. There was no much difference in the expenditure incurred on human labour. About 183 man days and 198 man days of labour was used to cultivate one acre of ginger. However in both the cases labour alone accounted for more than 24 per cent of the total cost. This is due to increase in wages of both male and female labour. The ruling wage rate at present for male and female labour was about Rs. 200 and Rs.150 respectively. The wage rates do not remain constant and are subjected to change over time resulted in higher cost of cultivation. This indicated that ginger generating substantial employment opportunities for local agricultural labour. FYM application is regular practice among the ginger farmers to supplement the plant nutrients. The quantity of FYM applied was in

the order of 7.85 tonnes worth Rs. 11464 and 8.90 tonnes worth Rs. 16651.25 in case of owner cultivated ginger and leased-in ginger farms respectively. Farmers apply substantial quantity of FYM to their ginger farms to maintain soil fertility during crop growth to achieve better output. Ginger farmers are in the habit of applying neem cake to their fields regularly at the rate of 388.75 kgs (Rs. 4354) and 401 kgs (Rs. 4494) in both the cases respectively. Application of neem cake controls the soil borne diseases and pests. Might be the reason applying regularly neem cake. Expenditure on chemical fertilizers came next only to FYM and seed material under both the situations. It was observed that farmers have been using chemical fertilizers indiscriminately without having regard to package of practice in a bid to obtain higher output. The recent hike in cost of fertilizers coupled with higher quantity has lead to higher expenditure on fertilizer. Hence there is need for extension education in the area to educate the farmers about the optimum use of fertilizers. Expenditure on plant protection chemicals came next in order with Rs. 7921 and Rs. 12202 in owner cultivated ginger and leased-in ginger farms. The farmers have taken adequate plant protection care by incurring substantial amount on plant protection chemical. Indiscriminate and frequent spray of plant protection chemical without adhering to recommended dosages to contain the menace of pests and diseases was the trends among the ginger farmers. The tendency of ginger farmers is to spray the crop before the occurrence of pest and disease problems as a preventive measure. Ginger is highly vulnerable to diseases particularly rhizome rot for which farmers are paying adequate attention and care. Among the fixed cost the share of land rent was highest under both the situations constituting 3.90 per cent and 14.5 per cent of total cost. The depreciation accounted for around 1 per cent under both the situation indicating lesser farms inventory.

5.5 Yields and returns of owner cultivated ginger and leased-in ginger farms.

The productivity of ginger was higher in leased-in ginger farms as compared to owner cultivated ginger farms. The leased-in ginger farms have been able to obtain 102 quintals of output which is probably due to better management practices adopted by leased-in ginger farms. Owner cultivated farms obtained gross returns of Rs.2,62,756.00 at an average price of Rs.3034. while the leased-in ginger farms obtained Rs. 3,09,468.00 from the sale of 102 quintals of ginger. The net returns realized by Owner cultivated farms were Rs.1,07,209 which is lower by Rs. 20,000 as compared to leased in farms. This was due to lower output obtained on owner cultivated farms. The benefit cost ratios have amply demonstrated the profitability of ginger. The result of the study supported by similar findings of Shafiqul islam *et. al.*(2012). It was evident that ginger production was profitable and average benefit cost (BCR) was found be 1.68 and 1.70 in owner cultivated and leased-in ginger farms respectively.

5.6 Input use intensity of owner cultivated ginger and leased-in ginger farms.

The quantity of seed material used in owner cultivated ginger farms was found to be less as compared to leased-in ginger farms. Leased-in ginger farms have the tendency to use higher quantity of seed material per unit area on their farms to obtain higher percentage of germination. Ginger farms have been using higher quantities of FYM notably on leased-in farms (8.90 tonnes per acre). FYM is an organic amendment that helps in fertility building thereby increases the output. Fertilizer was another important input which was used in larger quantities on leased-in ginger farms as compared to of owner cultivated ginger farms. The owner cultivated ginger farms were starved of capital and hence could not invest more on this critical input while counter parts were financially sound and afforded to use

this critical input in higher quantities. Micronutrients such as Ca, Zn, Mn, Bo were applied to ginger by the farmers under both the situations. The micro nutrients are vital source of the nutrients used in ginger as most of the soils are deficient in the study area. The micro nutrients are required for healthy crop growth. In the absence of micro nutrients the ginger fails to provide expected output. It could be seen in the Table that, the farmers applied micro nutrient ranging from 316.87 to 398.13 kgs in case of owner cultivated ginger and leased-in ginger farms. They have taken all the necessary care to apply micro nutrients to their ginger fields exhibiting greater awareness about use of micro nutrients among them. There has been no much difference with regard to usage of labor in ginger cultivation between the two farming situations. The above discussion leads to conclusion that ginger is highly resource intensive crop. The farmers are using more inputs than the recommended dosage both in case of owner cultivated and leased-in ginger farmers. The result of the study supported by similar findings of Shafiqul islam *et al* (2012) revealed that farmers in the study areas also used chemical fertilizers like urea, TSP, and MP at the rate of 122 kg, 137 kg, and 145kg per hectare, respectively. It was much lower than the recommended doses of i.e., urea (300-320) kg/ha, TSP (260-280) kg/ha, and MP (290-310) kg/ha (Modern cultivation practices of ginger in the hilly areas, 2009).

5.7 Sustainability of ginger cultivation.

The results of farms level sustainability analysis of owner cultivated ginger and leased-in ginger farms are discussed below.

In the order of their relative importance/influence on the production, the components were ranked. FYM were given the first rank, this might be due to getting high yield from the farms yard manure. Ratio of purchased ecological non destructive inputs to the total cost of cultivation was ranked last from the point of view of sustainability in both the cases. Fertilizer was given the highest

relative importance. Ratio of chemical fertilizers to total cost of cultivation was given the seventh and eighth rank because the cost of fertilizers is harmful to sustainability.

Weighted average of the ten sustainability indicators were developed for each farms separately for both owner cultivated and leased-in ginger farmers. The mean composite sustainability index was then worked out for each of the production systems. It could be observed that the mean sustainability index of leased-in ginger was significantly higher than owner cultivated ginger which indicates that, leased-in ginger is more sustainability compared to owner cultivated ginger.

5.7.1 Classification of sample farmers according to the sustainability index in case of owner cultivated ginger and leased-in ginger farms.

The classification of farmers based on sustainability index indicated that farmers cultivating leased-in ginger were significantly more skewed towards higher sustainability to owner cultivated ginger farmers. Supporting to this Nithya V.G (2007) assessing the sustainability of Bt cotton and non Bt cotton production systems in Haveri district revealed that farms level sustainability analysis showed Bt cotton was more sustainable with a higher and stable sustainability index of 0.66 compared to non Bt cotton (0.58).

5.8 Constraints in cultivation of ginger.

In order to study the constraints/Problems of ginger cultivation, the sample farmers were enquired about the various constraints faced by them in ginger cultivation. The constraints listed based on Garret scores. Revealed that the disease occurrence was the major constraint faced by the ginger farmers. The result of the study supported by similar findings of Shafiqul islam *et al* (2012) revealed that incidence of root rot disease ranked first as a problem of ginger production.

Other major constraints were high price of rhizome; insect infestation, lack of capital etc. were also reported by the ginger farmers.

VI. SUMMARY AND CONCLUSION

Ginger, the rhizome or the underground modified stem of the plant '*Zingiber Officinale Roscoe*' of Zingiberaceae' family, is an important commercial spice crop grown since ancient times in India. It consisting of more than 1200 plant species in 53 genera. The area under cultivation in India is 107.54 thousand ha and the total production of the country is 385.33 thousand tons. The total production of ginger in the world is 1683.00 thousand tons with the total acreage of 310.43 thousand ha. China, India, Nepal and Thailand are the major producers of ginger in the world. There is only marginal increase in acreage from 108.64 thousand ha in 2008-09 to 149.10 thousand ha in 2010-11.

Ginger is an important spice crop in India. India is the largest producer and exporter of ginger in the world. It's being cultivated extensively in the states of Kerala, Karnataka, West Bengal and Meghalaya. It is highly labour intensive crop providing profit and employment to small, marginal and land less agricultural labourers. Karnataka is also one of the state producing ginger in the country. The economic literature on this study lacking. In order to fill this void, the present study envisages throwing light on economic dimensions of the crop. The following are the specific objectives.

- To examine the land use and lease pattern in ginger cultivation.
- To study the comparative economics of ginger cultivation in leased in and owner cultivated lands.
- To assess the resource use efficiency and its implication on sustainability in ginger cultivation.
- To document the opinion of farmers regarding the problems and prospects of ginger cultivation.

The study was conducted in two taluks namely Hunsur and HD kote taluks of Mysore district. The primary data were collected from 40 each of owners operated and leased-in ginger farms randomly selected from 6 villages which is spread over in the above taluks. The data were analyzed using simple and conventional tabular method of analysis, production function analysis, sustainability analysis and garret ranking technique.

Major findings of the study

- There was no difference in socio-economic characteristics like age and family size. It was found that there is a significant difference in average annual income as well as percentage of area under ginger between owners operated ginger farms and leased-in ginger farms.
- Owner operated farms had allocated 41 per cent of their land holding for ginger cultivation. The leased-in ginger farms had spared 59 per cent of the land holding for ginger alone.
- Majority of the farmers who leased out lands were marginal farmers (75 %) followed by small farmers (58 %), medium farmers (43 %) and large framers (36 %).
- Majority of the farmers who leased-in land were large farmers (47.24 %) followed by medium farmers (42.5 %), small farmers (38.4 %) and marginal framers (25 %).
- Expenditure on rhizomes, farms yard manure and fertilizers, were substantially higher in case of leased-in ginger farms (Rs.46321.50, Rs16651.25. and Rs11121.03. respectively) compared to that of owner operated ginger farms (Rs.38187, Rs11464.50 and Rs.9078 respectively) indicating leased-in farms have invested more on these crucial inputs. The study further suggested that ginger is highly capital intensive crop.

- Leased-in ginger farms had realized higher gross and net returns (Rs. 3,09,468 and Rs. 1,27, 838 per acre respectively) than owner operated ginger farms (Rs. 2, 62,756 and Rs. 1,07,209 per acre respectively). B:C ratio indicated that leased-in ginger farms (1.70) were getting higher return per rupee of investment compared to owner operated ginger farmers (1.68) testifying that ginger is highly remunerative crop.
- In case of both owners' operated and leased-in ginger cultivation the farmers found to use higher dosage of inputs than the recommended dosage. The deviation from the recommended dosage was highest in case of leased in ginger. Farmers used (173 %) of fertilizer more than the recommended in case of leased-in ginger farms compare to owner operated farm (122.5 %).
- The production function analysis indicated that the co-efficient of expenditure on rhizomes, fertilizers, irrigation and plant protection chemicals were significant in case of leased-in ginger cultivation while that of rhizome, fertilizers and irrigation had significant co-efficient owner operated ginger farms indicating these variables influence the ginger production.
- The ratio of MVP to MFC for rhizomes, farms yard manures, fertilizer, labour, plant protection chemicals and irrigation were 0.61, 0.57, 0.45, 0.45, 0.90, 0.63 respectively in case of owner operated ginger farms and in case of leased-in ginger farms the ratios were 0.74, 0.02, 0.03, 0.32, 0.43, 0.15 respectively.
- Farms level sustainability analysis showed that ginger cultivation was less sustainable as indicated by the indices in both the cases.
- The major constraints in the cultivation of ginger were high incidence of diseases particularly ginger rot, high cost of seed

material, non availability of varieties, low quality seed material, high input cost and low yield as reported by the farmers.

Policy implications

- As revealed in the results the ginger cultivation in the study area is marked by intensive use of agrochemicals and water. This will cause the problem of environmental unsustainability of soil very soon. Hence proper extension services along with regulation method are needed to prevent such eventualities in the region.
- It was observed during the course of study, the ginger cultivation is under taken through land leasing arrangement by the outside people especially from Kerala. This mechanism needs to be regulated so as to prevent any form of exploitation either to the farmers or to the agro-ecosystem. This is more crucial as the majority of farmers who leased out lands are small and marginal framers.
- R & D efforts needs to be strengthened to evolve suitable varieties and tackle the diseases such as ginger rot.
- In the back drop of over use of fertilizers and plant protection chemicals more sustainable, environmental friendly, Good Agricultural Practices (GAP) need to be evolved for crops like ginger.

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APPENDIX-I

Table 1.1: Area, production and productivity of ginger in the World (2012-13)

Country	AREA (000' Hectare)	PRODUCTION (000' Tons)	PRODUCTIVITY (Tons/Hectare)
China	36.10	396.60	10.99
India	107.54	385.33	3.58
Nepal	18.04	210.79	11.68
Thailand	10.25	172.68	16.85
Nigeria	52.33	162.22	3.10
Indonesia	60.47	109.02	1.80
Bangladesh	9.07	74.84	8.26
Philippines	3.97	27.10	6.83
Republic	2.09	24.97	11.98
Sri Lanka	2.07	12.05	5.82
Other countries	8.51	107.39	12.62
Total	310.43	1683.00	5.42

Source: FAO (2012-13)

Table 1.2: Area, production and productivity of ginger in India (2012-13).

YEAR	AREA (000'Hectare)	PRODUCTION (000'Tons)	PRODUCTIVITY (Tons/Hectare)
2008-09	108.64	380.10	3.50
2009-10	107.54	385.33	3.60
2010-11	149.10	702.00	4.70
2011-12	118.17	398.00	3.70
2012-13	107.54	385.83	3.58

Source: National Horticulture Board (2010-11).

APPENDIX-II

Table 1.3: State-wise Area, Production and Productivity of Ginger in India (2012-2013).

States	Area (‘000 Hectare)	Production (‘000 MT)	Productivity (MT/Hectare)
Andhra Pradesh	2.32	20.00	8.62
Arunachal Pradesh	6.80	53.00	7.79
Assam	16.99	125.42	7.38
Chhattisgarh	1.07	1.42	1.32
Gujarat	4.40	70.65	16.07
Haryana	0.57	7.79	13.66
Himachal Pradesh	2.18	16.76	7.69
Karnataka	40.00	139.60	3.49
Kerala	5.83	31.60	5.42
Madhya Pradesh	9.00	15.00	1.67
Maharashtra	1.06	1.04	0.98
Manipur	2.40	3.84	1.60
Meghalaya	9.44	56.8	6.02
Mizoram	6.50	37.00	5.69
Nagaland	5.32	36.00	6.77
Odisha	15.84	35.00	2.21
Sikkim	8.51	48.00	5.64
Tamil Nadu	0.46	7.07	15.3
Tripura	1.80	7.60	4.22
Uttarakhand	1.40	11.84	8.46
West Bengal	11.50	25.00	2.17
India	155.06	755.62	4.87

Source: Indiastat.com (2012-13)

APPENDIX-III

Table 1.4: Area, production and productivity in major ginger growing districts of Karnataka (2011-12).

District	Area (HECTARES)	Production (TONS)	Productivity (TONS/HECTARE)
Coorg	1386	16024	11.56
Hassan	1103	11334	10.28
Mysore	898	9423	10.49
Dakshina kannada	323	3298	10.21
Chikkamagalur	567	5670	10.00
Chamrajnagar	64	640	10.00
Shimoga	29	194	6.68
Uttara Kannada	5.6	16	2.85
Bidar	1.7	4	2.94
Belgaum	1.1	3	2.72
Bagalkot	0.7	2	2.85

Source: National Horticultural Board (2011-12).

APPENDIX-IV

Table 3.1: Land utilization pattern in Karnataka (2011-12)

SL.NO.	CLASSIFICATION	AREA (HA)
1	Total geographical area	190498.36
2	Forest	3068353 (16)
3	Land put to non agricultural use	1312160 (6.9)
4	Barren and uncultivable land	793986 (4.2)
5	Permanent pastures and other grazing land	959224 (5.0)
6	Land under miscellaneous tree not included in net area sown	303389 (1.6)
7	Cultivable waste	426584 (2.2)
8	Fallow other than current fallow	408505 (2.1)
9	Current fallow	1367183 (7.2)
10	Net area sown	10410452 (54.7)
11	Area sown more than once	1873946 (9.8)
12	Total cropped area	12284398 (64.5)

Source: District Statistical office (2012)

Note: Figures in parentheses indicate percentage to total geographical area.

APPENDIX-V

Table 3.2: Land utilization pattern in Mysore district (2011-12)

SL. NO.	CLASSIFICATION	AREA (HA)
1	Total geographical area	685932.00
2	Forest	43906.00 (6.40)
3	Land put to non agricultural use	6789.00 (0.98)
4	Barren and uncultivable land	546.00 (0.07)
5	Permanent pastures and other grazing land	878.00 (0.12)
6	Land under miscellaneous tree not included in net area sown	421.00 (0.06)
7	Cultivable waste	608.00 (0.08)
8	Fallow other than current fallow	887.00 (0.12)
9	Current fallow	2987.00 (0.43)
10	Net area sown	30121.00 (4.39)
11	Area sown more than once	13789 (2.01)
12	Total cropped area	5,85,000.00 (85.28)

Source: District Statistical office (2011-12)

Note: Figures in parentheses indicate percentage to total geographical area.