AN ECONOMIC ANALYSIS OF ACID LIME CULTIVATION IN NELLORE DISTRICT OF ANDHRA PRADESH WITH SPECIAL REFERENCE TO VARIETY BALAJI

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B.Sc. (Ag)

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(AGRICULTURAL ECONOMICS)

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BY

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B.Sc. (Ag.)

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DECLARATION

I, **Ms. G. SHIREESHA** hereby declare that the thesis entitled **"AN ECONOMIC ANALYSIS OF ACID LIME CULTIVATION IN NELLORE DISTRICT OF ANDHRA PRADESH WITH SPECIAL REFERENCE TO VARIETY BALAJI"** submitted to the **Acharya N.G. Ranga Agricultural University** for the degree of **MASTER OF SCIENCE IN AGRICULTURE** is the result of original research work done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

Place : Tirupati **(G. SHIREESHA)**

Date : **I.D.No. TAM/2015-013**

CERTIFICATE

This is to certify that **Ms. G. SHIREESHA** has satisfactorily prosecuted the course of research and that the thesis entitled **"AN ECONOMIC ANALYSIS OF ACID LIME CULTIVATION IN NELLORE DISTRICT OF ANDHRA PRADESH WITH SPECIAL REFERENCE TO VARIETY BALAJI"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by her for a degree of any university.

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This is to certify that the thesis entitled "**AN ECONOMIC ANALYSIS OF ACID LIME CULTIVATION IN NELLORE DISTRICT OF ANDHRA PRADESH WITH SPECIAL REFERENCE TO VARIETY BALAJI"** submitted in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURE** of the Acharya N G Ranga Agricultural University, Guntur is a record of bonafide research work carried out by **Ms .G. SHIREESHA** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance and help received during the course of investigation have been duly acknowledged by the author of the thesis.

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Shireesha…

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LIST OF SYMBOLS AND ABBREVIATIONS

%	:	per cent
₹	:	Rupee
BCR	:	Benefit Cost Ratio
et al.	:	and others
etc.	:	and so on
Fig.	:	Figure
FYM	:	Farm Yard Manure
i.e	:	that is
viz.,	:	namely
IRR	:	Internal Rate of Returns
NPW	:	Net Present Worth

ABSTRACT

Author of the thesis	:	**Ms. G. SHIREESHA**
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The present study entitled “An economic analysis of acid lime cultivation in Nellore district of Andhra Pradesh with special reference to variety balaji” was intended to examine the cost structure and economic viability in the cultivation of acid lime orchards. The study was carried out in Nellore district of Andhra Pradesh. Four mandals and eight villages having maximum area under balaji and local varieties were selected. All the acid lime orchardists of balaji and local varieties in the selected villages were listed out and 80 farmers were selected at random. 40 farmers from each balaji and local varieties of acid lime constituted the sample for the detailed study. The primary data were collected by survey method through well structured schedule for the agricultural year 2015-16. The data were analyzed by using conventional analysis and project evaluation techniques.

The total labour requirement during 15 years of acid lime orchard stood at 6171.19 mandays per hectare on balaji variety farms and 5380.38 mandays per hectare on local variety farms. The important labour absorbing operations were harvesting (1738 and 1172.5 mandays), irrigation (975 and 729 mandays), application of manures and fertilizers (728.6 and 838 mandays) and weeding (718 and 669 mandays) on balaji and local varieties of acid lime orchards.

The total cost for the 15 years of acid lime orchards worked out to ₹ 24,87,200.40 on balaji variety orchards as against ₹ 22,00,066.62 on local variety farms. Of the total cost, human labour was the highest item of the cost accounting for 44.98 per cent and 44.16 per cent of the total cost on the above said categories of farms respectively. Orchardists of balaji variety and local variety realized a net income of ₹ 12,82,797 and ₹ 7,81,047.40 per hectare respectively. The orchardists incurred ₹ 1,542.93 and ₹ 1,702.83 to produce a quintal of balaji and local varieties of acid lime respectively.

The NPV, B-C Ratio and IRR on balaji and local varieties worked out to ₹ 95,149.59 and ₹ 5,878.26, 1.25 and 1.01 at 24 per cent discount rate and 33.17 per cent and 24.6 per cent respectively. The project evaluation techniques revealed that acid lime production was economically viable in the case of both the varieties. However, the capital productive was higher on balaji variety orchards than on local variety farms.

Chapter ~ I

Introduction

Chapter - I

INTRODUCTION

Agriculture plays a vital role in India's economy. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. As per estimates by the Central Statistics Office (CSO), the share of agriculture and allied sectors (including agriculture, livestock, forestry and fishery) was 15.35 per cent of the Gross Value Added (GVA) during 2015-16 at 2011-12 prices.

Horticulture potential in India is much more than what has been realized so far. Apart from helping the country in achieving nutritional security by bridging the nutritional gap, horticultural crops also help in maintaining ecological balance through increased biomass production per unit area. On account of their labour intensiveness these crops generate employment opportunities for rural masses and are more remunerative than other crops. Horticulture activity leads to development of industrial base in rural areas through establishment of fruits and vegetable processing units and helps in curtailing migration of rural population to urban area. Finally, horticulture has tremendous export potential especially with value added activity and horticulture development could be looked upon as means of earning foreign exchange for the country.

Horticulture has been continuously outpacing food grain production in the country. Economic survey 2015-16 notes that the percentage share of horticulture output in agriculture is more than 33 per cent. Under the purview of agriculture and allied activities, the share of plan outlay for horticulture which was 3.9 per cent during the 9^{th} plan has increased to 4.6 per cent during the 12^{th} plan.

India has witnessed voluminous increase in horticulture production over the last few years. Significant progress has been made in area expansion resulting in higher production. The production of horticultural crops was about 283.5 million tonnes from an area of 2.42 million hectares during 2015-16 (Shivay and Rahal, 2016).

After China, India ranks among the largest producers and leading exporters of flowers, fruits and vegetables in the world and has immense scope for improvement in the fourth coming years. India exports different types of fruits. During 2015-16, India exported fruits and vegetables worth ₹ 8,391.41 crores which comprised of fruits worth ₹ 3,524.50 crores and vegetables worth ₹ 4,866.91 crores. Mangoes, wallnuts, grapes, bananas, pomegranate account for larger portion of fruits exported from the country while onions, okra, bitter gourd, green chillies, mushrooms and potatoes contribute largely to the vegetable export basket. The major destinations of Indian fruits and vegetables are United Arab Emirates (UAE), Bangladesh, Malaysia, United Kingdom (UK), Netherland, Pakistan, Saudi Arabia, Srilanka and Nepal (National Horticulture Board).

Citrus fruits have many merits. They are available throughout the year. They are not only delicious and refreshing to eat but also provide vitamins, minerals and many other essential substances required for human health. They are especially important for growing children and are important source of vitamin C. Citrus fruits are mostly consumed as fresh as particularly mandarins, sweet oranges, pumello and grape fruit. Lemon and lime being acidic are not generally consumed as fresh but mostly used for flavouring vegetable dishes, meat and salads. They make delicious and refreshing cold drinks. Mandarin and sweet orange are used in the preparation of squashes and limes are mainly used in the preparation of pickles.

Acid lime is available round the year in India. These are used as acidulant, juice, squash, syrup, marmalade, pickle, salted lime and dried peels. The by-products like essential oils and pectin are also manufactured from acid lime. The preparation of lime syrup and pickle can be done at home as a lucrative business for generating an additional income.

The production of horticultural crops in Andhra Pradesh was 17.32 million tonnes from an area of 1.35 million hectares during 2015-16. Major share of production is from vegetables (51 per cent) and fruits (40 per cent). Andhra Pradesh is a leading lime/lemon producing state in the country with a production of 0.69 million tonnes from 0.05 million hectares with productivity of 15 tonnes per hectare. The state contributes about 33 per cent of total production of lime/lemon in the country. Acid lime is grown in almost all the districts of Andhra Pradesh and the largest area is in semi-arid regions of Nellore, YSR Kadapa, Prakasham, Guntur, West Godhavari, East Godhavari and Anantapur districts. 13.67 lakh tonnes of citrus have been traded in organized markets with an average price of ₹ 6.83 per kg.

Nellore district has the highest area under acid lime (21128 ha) contributing 50 per cent of total production (316920 tonnes). The Gudur market in Nellore district is the biggest acid lime market in the country exporting acid lime fruits to North India all throughout the year.

PROBLEM SETTING

Being a rich source of nutrient, cultivation of acid lime brings higher income to farmers. It is an important fruit crop among the various fruits grown in India. There exists possibilities of value addition through processing of acid lime fruits which inturn offers vast opportunities for employment and income generation. Nellore district of Andhra Pradesh is well known for acid lime cultivation. A new variety namely balaji was introduced in the district in the year 2002. Very few research studies have been attempted so

far to study economic aspects of acid lime production in the study area. No research has been conducted so far to examine the economic viability of balaji variety of acid lime orchards. So it is felt necessary to probe into the economic aspects of acid lime orchards of balaji and local varieties in Nellore district of Andhra Pradesh with the following objectives.

OBJECTIVES OF THE STUDY

1. To study the investment pattern in the establishment and maintenance of acid lime orchards.
2. To compare the costs and returns of acid lime variety balaji with other variety.
3. To study the financial viability of acid lime orchards and
4. To identify the production and marketing constraints in the cultivation of balaji acid lime.

SCOPE OF THE STUDY

The results of the study provide information on the investment required for establishment of acid lime orchards, cost structure, returns, financial viability and production and marketing problems of acid lime. This information is useful to the existing acid lime orchardists in planning for higher returns and to the new entrepreneurs who plan for the establishment of acid lime orchards. The findings of the study are also useful to the institutional financing agencies in estimating the credit requirements for acid lime orchards. It also provides information on the magnitude of employment opportunities as a result of investment in acid lime cultivation.

LIMITATIONS OF THE STUDY

Research studies conducted by individuals are always confronted with various bottlenecks and hence the present study is not an exception to such limitations. The study was confined for a particular agro-climatic region and conclusions drawn are applicable to similar areas only. Further, the primary data regarding production of acid lime were collected from respondents based on their memory recall by interview method, but utmost care had been taken in collecting data. The study was carried out in a limited period of time and limited size of sample and hence generalization of results is not advisable.

PLAN OF THE THESIS

The thesis is presented in five chapters. In the introductory chapter, the economic importance of acid lime, objectives, scope and limitations of the study are presented. The second chapter is devoted to review the past research work done on economic aspects of acid lime and other related plantations. The third chapter deals with the sampling design, methods of collection of data and economic evaluation techniques employed. The fourth chapter presents critical analysis of results and discussions. The last chapter presents the summary and conclusions of the study.

Chapter ~ II

Review of Literature

Chapter - II

REVIEW OF LITERATURE

An effort has been made in this chapter to critically review the literature of the past research work done relevant to the present study. Such a review of earlier studies and past experience of specialists in the relevant field is very much helpful in providing guidelines to the present researchers and to know the strengths and weaknesses of the concepts used earlier and also to study different results obtained and the policy implication there on. Since the literature on acid lime is limitedly available, literature on some related perennial crops was also reviewed.

For better exposition, the review has been discussed under the following heads.

2.1 Studies on costs and returns

2.2 Studies on economic feasibility

2.3 Studies on problems in production and marketing

2.1 STUDIES ON COSTS AND RETURNS

Randhawa and Srivastava (1986) estimated the production cost per hectare for mandarin oranges at ₹ 3,800, ₹ 1,325, ₹ 1,475, ₹ 1,950, ₹ 2,765, ₹ 3,015, ₹ 3,677 and ₹ 4,375 from first to eight years respectively. From 8th year onwards the cost was same for the remaining crop life.

Subramanyam (1986) divided the cost of cultivation of acid lime and sweet orange into establishment cost (planting cost as well as maintenance cost upto bearing) and maintenance cost (after fruit bearing). The amortized establishment costs were ₹ 59.67 and 67.92, maintenance costs were ₹ 918.63 and ₹ 679.58, overhead costs were ₹ 3,119.45 and ₹ 2,652.93 and

total costs per year were ₹ 4,632.75 and ₹ 4,009.43 in lime and sweet orange orchards respectively per hectare per year.

Mahalle and Galgalikar (1987) estimated cost of establishment of Kagzilime orchard. The net returns received from intercrops were deducted from gross cost of establishment to obtain the net cost of establishment of lime orchard. The quantities of key inputs per hectare utilized in establishing orchard increased every year from first to seventh year. The total gross cost and net cost of establishment of lime orchard for all six years worked out to ₹ 16,770.00 and ₹ 12,736.00 per hectare respectively.

Azad *et al.* (1988) reasoned that the initial investment in raising a citrus orchard was high for reasons of cost involved in digging and filling of pits, manures and fertilizer application, cost of plant *etc*. Initial cost of citrus (orange) plantation was ₹ 2,565.00 per hectare. About 37 per cent of the total cost was incurred on layout, digging and filling of pits *etc.*, and 40 per cent on nursey plants, 19 per cent on manures and fertilizers. There was a positive relationship between maintenance cost and age of plants. The total cost varied between ₹ 9,642.00 and ₹ 22,421.00 per hectare in bearing orange orchards for various age groups.

NABARD (1988) in its project on coconut development in Quilan district of Kerala studied the per acre investment costs and maintenance costs of coconut garden and found out that the actual investment costs per acre estimated at 1971-72 prices were ₹ 5,564. The maintenance costs per year of a full developed garden worked out to be ₹ 1,284 per acre (including the imputed value of family labor). During the pre-full development stage the annual cost of cultivation excluding the imputed value of family labour ranged from ₹ 892 in 7^{th} year to ₹ 1,160 in 13^{th} year. The average gross income per acre realized by sample beneficiaries of full development stage was ₹ 9,900.

Nallathambi *et al.* (1988) in their study on production costs and retuns of coconut cultivation observed that the cost of establishing one hectare of coconut garden worked out to ₹ 23,804 and ₹ 33,254 under rainfed and irrigated conditions respectively for the initial 7 years period excluding the interest on investment. The production cost for the same was estimated at ₹ 1.18 and ₹ 1.10 per nut respectively and respective annual net returns worked out to ₹ 5,197 and ₹ 8,277 per hectare.

Srinivas (1989) in his study on economics of coconut cultivation in east Godavari district of Andhra Pradesh revealed that the cost of establishment of one hectare of coconut garden was ₹ 4,692.47 in 1st year. The cost of maintaining one hectare of garden from 2nd year to 6th year was in the order of ₹ 4,091.13, ₹ 3,993.71, ₹ 4,146.85, ₹ 4,059.71 and ₹ 4,659.00 respectively. The maintenance costs from 7th year (bearing period) onwards were ₹ 6,201.37. The per hectare gross income and net income over cost stood at ₹ 40,860.73 and ₹ 15,152.25 respectively.

Job and Prakash (1990) found that the total maintenance cost per hectare of coconut was ₹ 4,975. Gross returns per hectare stood at ₹ 12,569 which included returns from nuts (₹ 11,680) and returns from by-products (₹ 889).

Sivanantham *et al.* (1990) in their study on economics of cashew production in Tamilnadu worked out the average return from apple at ₹ 385 per hectare in local variety. The respective gross return by sale of nuts and apple was ₹ 12,110 and ₹ 1,515 per hectare in the case of improved variety. The net return from the improved variety was ₹ 9,229 higher than the local variety.

Srinivas (1991) calculated the total cost of establishment of cashewnut orchard in Prakasam district of Andhra Pradesh during the first year at ₹ 3,588.97. About ₹ 2,524.29 was incurred on labour and ₹ 1,057.11 on

material inputs. The cost of establishment from second and fifth year was ₹ 1,582.57, ₹ 1,601.24, ₹ 643.72 and ₹ 518.48 respectively. Maintenance cost during bearing period (from 6th year onwards) was ₹ 903.48 which remained the same for every year till the end of life of the orchard. The annual share of establishment cost calculated at 15 per cent discount rate was ₹ 119.62 per hectare.

Mallareddy *et al*. (1993) working on annual costs and returns of sweet orange in Prakasam district of Andhra Pradesh reported that the expenditure on manures and fertilizers contributed about 47 per cent of total variable costs. Farmers with large orchards (>2.5 acres) obtained higher yields than those with small orchards (<2.5 acres). The cost of production was lower for larger orchards than for small orchards (₹ 64 and ₹ 81 per thousand fruits, respectively).

Hiremath *et al*. (1995) while studying the role of intercrops in reducing establishment cost of lime orchards worked out cost of establishment of orchard at ₹ 56,429.58 in small, ₹ 49,179.62 in medium and ₹ 47,143.09 in large orchards per hectare. The intercrops grown helped the farmers in reducing the establishment cost of lime orchards to the extent of 58.82 per cent in small, 53.90 per cent in medium and 46.88 per cent in large orchards.

Koujalagi and Kunnal (1996) studied labour use pattern and costs and returns in pomegranate orchards. The total cost of cultivation per acre was worked to ₹ 2,887.93. The major component of cost of cultivation was labour (42.75% of total cost) followed by expenditure on manures and fertilizers (33.19% of total cost) and interest on working capital (10.71%).

Lavanya (1996) studied economics of acid lime production in Kadapa district and observed that total cost of establishment in first year was ₹ 9,968.21 of which labor accounted for 58.52 per cent and material 41.48 per cent. In second and third years the costs incurred were ₹ 5,571.48 and

₹ 6,015.10 per hectare respectively. The maintenance costs from fourth to eight year were found to be ₹ 8,185.63, ₹ 9,236.43, ₹ 10,786.96, ₹ 13,406.68 and ₹ 17,660.10 per hectare respectively. The total cost of production was ₹ 40,799.31 per hectare of which direct costs accounted for 48.48 per cent and indirect 51.52 per cent.

Vandana *et al*. (1996) estimated the total cost of establishment of acid lime during first year to be ₹ 9,946.11 per hectare of which labor accounted for 58.33 per cent and material 41.47 per cent. In second and third years the costs incurred were ₹ 5,710.57 and ₹ 7,369.49 per hectare respectively. The maintenance cost per hectare from fourth to seventh year was found to be ₹ 9,089.60, ₹ 12,006.67, ₹ 14,296.38 and ₹ 18,184.64 respectively. From eighth year onwards the maintenance cost was ₹ 19,797.05 per hectare. The total cost of production of acid lime per hectare was ₹ 38,719.81 of which direct cost constituted 51.93 per cent and indirect costs 48.07 per cent.

Sairam *et al*. (1997) in their study estimated cost of cultivation of coconut based on 1995-96 prices under rainfed conditions ranged from ₹ 28,600 per hectare during the first year of planting to ₹ 23,450 per hectare during the stabilized bearing period. The same under irrigated condition ranged between ₹ 52,650 and ₹ 27,750 per hectare and the cost of production was estimated as ₹ 3.30 per nut and ₹ 2.60 per nut under rainfed and irrigated conditions respectively.

Sairam *et al*. (1998) worked out the per hectare cost of cultivation of rainfed coconut during the first stage as ₹ 14,400, ₹ 14,600 and ₹ 15,100 for small, medium and large farms respectively. In second stage, the same was ₹ 9,900, ₹ 10,400 and ₹ 11,300 for the above said farms. The respective figures for the third stage stood at ₹ 15,400 ₹ 16,200 and ₹ 16,500. The maintenance cost of irrigated coconut was ₹ 15,400, ₹ 16,200 and ₹ 16,500 respectively for the corresponding farms. Respective gross returns worked

out to ₹ 37,600, ₹ 42,500 and ₹ 42,500 and the net returns were ₹ 11,000, ₹ 12,100 and ₹ 13,600 for small, medium and large farms respectively.

Murthy (1999) in his study worked out establishment cost per hectare of coconut as ₹ 9,848.30. The costs incurred in maintaining a hectare of garden from second year to sixth year were ₹ 6,307.36, ₹ 6,437.46, ₹ 6,218.04, ₹ 6,746.05, respectively. The maintenance cost incurred from seventh year onwards was ₹ 11,479.30 per hectare per year. The gross and net returns obtained per hectare of garden were ₹ 49,723.98 and ₹ 38,244.08 per year respectively.

Rao and Krishnaiah (2001) while analysing the cost of production of cashewnut in Srikakulam district of Andhra Pradesh observed that the establishment cost per hectare amounted to ₹ 6,686.87 and the maintenance cost was ₹ 5,967.92 per hectare. Gross and net returns stood at ₹ 20,953.21 and ₹ 7,059.23 per hectare respectively.

Mallika (2002) found that the total labour required to establish and maintain the coconut orchard during the economic life period was ₹ 11,627.18 man days per hectare of which irrigation, harvesting and watch and ward took major share with 3,400 man days (29.25%), 2,789.65 man days (23%) and 2,640 man days (22.71%) respectively. The commercial cost of cultivation (cost C) for the life span of coconut orchard was ₹ 22,00,456.90 per hectare. The gross and net income realized for the entire economic life period were ₹ 30,73,116.00 and ₹ 8,92,650.10 per hectare respectively.

Bastine *et al*. (2004) worked out the establishment cost of coconut (upto seven years) garden to be ₹ 1,22,129 and the annual maintenance cost ₹ 24,690.66 and the cost of production to be ₹ 4.13 per nut.

Kalathiya *et al*. (2007) estimated the investment (including maintenance) of bearing coconut garden at ₹ 7,896.43, ₹ 7,159.37, ₹ 8,220, ₹ 6,603.10 and profit ₹ 14,2225.71, ₹ 13,066.06, ₹ 9372.07, ₹ 13,413.50 per hectare for marginal, small, medium and large farmers respectively.

Chakraborthy and Bera (2008) found that the total cost of cultivation, total returns and net returns over cost of cultivation per acre of pine apple in Darjeeling district of West Bengal were ₹ 1,19,104.23 ₹ 1,49,750.62 and ₹ 30,646.30 respectively and return-cost ratios estimated at subsequent stages were of the order of 1.64, 1.57, 1.29 and 1.26 when all the sample farmers were taken together. Net returns would have been greater if it was estimated by applying prime cost concept of cost of cultivation. Inter-farm size comparison in terms of different cost concepts revealed that there was an increasing trend with the increase in farm size, but the net returns over different cost concepts used in the study and returns-cost ratios were found to have decreased with the increase of farm size at subsequent stages.

Hassan (2010) in her study estimated the commercial cost of cultivation (cost C) for the life span of arecanut garden at ₹ 34,52,903.35 per hectare. The cost of producing a quintal of arecanut was ₹ 4,346.07. The arecanut growers realized a gross income of ₹ 7,500 and a net income of ₹ 3,153.93 per quintal.

Naveen *et al*. (2010) observed that the per hectare establishment cost was ₹ 3,94,377.44 in grapevine orchards. The total maintenance cost during bearing period was ₹ 1,86,043.25. The average yield was 14 tonnes per hectare per year and average returns were ₹ 5,29,787.

Kumar *et al*. (2011) revealed that the cost of establishment per hectare was found to be ₹ 1,90,888.41 and ₹ 1,89,644.33 of which material cost constituted 56.87 and 58.15 per cent and maintenance cost 43.13 and 41.85 per cent in Challakare and Hiriyur thaluks respectively. The average per

hectare maintenance cost incurred by respondents in Challakare and Hiriyur thaluks was ₹ 82,320.70 and ₹ 79,368.02 respectively during the first three years. The average per hectare maintenance cost incurred by the respondents in Challakare thaluk was ₹ 23,148.67 while the same in Hiriyur thaluk was ₹ 24,306.31. The net returns obtained were ₹ 1,40,588.18 and ₹ 1,37,352.27 in Challakare and Hiriyur thaluks respectively.

Ramanan (2012) in his study on cost of production and capital productivity of grape cultivation in Tamilnadu estimated the per hectare establishment cost at ₹ 2,41,986 and the annual operational and maintenance cost of bearing orchard at ₹ 48,284.05. He also revealed that the cost of production was ₹ 7.59 per Kg.

Lama and Sarker (2013) in their study revealed that mandarin orange growers in Takdah block received higher net income (₹ 1,02,493) as against the growers in Kalimpong block (₹ 24,668) and Bijanbari block (₹ 99,437). Further, they reported that the overall net income received by the growers was ₹ 75,532 per hectare.

Manasa Veena (2013) in her study on economics of production of mango under drip and surface irrigation systems in Chittor district worked out the per hectare total cost for entire life span of mango orchard to be ₹ 22,85,671.42 on surface irrigated farms against ₹ 23,04,545.08 on drip irrigated farms. Of the total costs, the opportunity cost on owned land was the highest item of cost with ₹ 8,58,000 each on surface and drip irrigated farms. This item of expenditure accounted for 37.54 per cent and 37.23 per cent of the total costs on surface and drip irrigated farms respectively. The net income obtained from a hectare of mango orchard during its economic life span of 40 years stood at ₹ 32,97,855.17 and ₹ 36,92,631.41 on surface and drip irrigated farms respectively.

Charuporwal (2014) studied the growth rates, cost of cultivation and production of mandarin in Jhalawar district of Rajasthan. The study revealed that the establishment cost of mandarin crop on an average was ₹ 71,584.97 per hectare. The total cost of cultivation of mandarin was estimated at ₹ 46,933.16 per hectare, with ₹ 5941.55 per hectare per year as establishment cost and ₹ 40,991.61 per hectare per year as maintenance cost. The per hectare return from mandarin cultivation on an average was estimated at ₹ 1,12,000 for the life span of one year. The average net return of mandarin cultivation was estimated at ₹ 65,066.84 per hectare.

Christain *et al.* (2014) revealed that the citrus cultivation was profitable with average returns of 1,77,206 per hectare per year against the per year expenditure of 1,66,792.

Datarkar *et al.* (2014) estimated per hectare establishment cost of mango orchard during five years for all age groups of orchard at ₹ 41,796.08. Among different items of expenditure, share of human labour was higher followed by bullock labor per hectare. Cost of cultivation of mango orchard for the sample as a whole was ₹ 63,964.85. Further, it was found that the gross income for the sample as a whole as ₹ 1,48,956.00 per year per hectare.

2.2 STUDIES ON ECONOMIC VIABILITY

Jayaraman (1981) while evaluating the profitability of cashew enterprise worked out the IRR as 60 per cent for adopters of new packages and 50 per cent for non-adopters and showed that the investment in cashew would be much profitable since this discount rate was high above the market rate of interest.

Raja (1981) in his study on arecanut garden revealed that the net present worth stood at ₹ 18,124, ₹ 22,157.41 and ₹ 25,999.41 per hectare for small, medium and large gardens respectively. The respective benefit-cost

ratios were 1.43, 1.57 and 1.66 with the internal rate of return of 22.28, 26.28 and 27.53 per cent.

Job and Mukundan (1984) while studying the worthiness of investment in rubber plantations measured the productivity of capital and reported that BCR, IRR and NPV were 2.04, 24.20 per cent and ₹ 25,397 respectively.

Subramanyam (1986) revealed that lime was more profitable than sweet orange with a pay back period of four years, benefit cost ratio of 2.42 and a capital value of ₹ 36,000 per hectare compared to 6 year pay back period, 2.27 benefit cost ratio and ₹ 25,602 per hectare capital value of sweet orange at 12 per cent discount rate. Life span considered were 25 years for lime and 30 years for sweet orange orchards.

Arora and Dhruvanarayana (1987) revealed that plantation of lemon "Eureka Round" and mandarin "Kinnow" were economically viable proposition in waste land in doon valley under rainfed or protective irrigation condition. The payback period for lemon and mandarin plantation were 12 years and 10 years respectively at 15 per cent interest rate.

Nagaraj *et al*. (1987) examined the profitability and economic feasibility of investment in coconut enterprise and found out that the NPW for the entire project was ₹ 77,167. The discounted benefit cost ratio was 1.69 at 12 per cent discount rate and the IRR was 21.40 per cent.

Subramanyam (1987) observed that 11 years were required to get back the capital invested in mango orchards in Karnataka. Internal rate of return was 30 per cent and B-C ratio was 2.00 indicating that the investment was profitable.

Thakur *et al*. (1987) in their study on kinnow plantations in Himachal Pradesh revealed that kinnow plantation is quite profitable with the BCR of 3.04 (on gross returns) and 2.04 (on net returns) and the IRR was as high as 46 per cent.

Azad *et al*. (1988) in their study on measures of investment worth per hectare of orange cultivation in Himachal Pradesh estimated payback period as 8 years, net present value as ₹ 21,184 internal rate of return as 29.9 per cent and benefit cost ratio as 1:1.5.

Patil *et al*. (1989) in their study on economic evaluation of coconut plantation in Maharashtra, found that the BCR and NPV at 10 per cent discount rate stood at 2.27 and ₹ 18,186 respectively, where as the IRR was 22.06 per cent.

Srinivas (1989) in his study on coconut plantation estimated the benefit cost ratio, payback period, net present value and internal rate of returns as 1.94, 12.6 years, ₹ 31,317.69 and 22.82 per cent respectively.

Goswami (1990) carried out investment analysis of plum and mandarin plantations and worked out the NPW for plum and mandarin plantations at ₹ 6,884.83 and ₹ 10,216.76 respectively. The respective values of BCR were 1.38 and 1.52.

Vijuipe and Varghese (1990) in their study on economics of nutmeg cultivation in kerala estimated the NPW, BCR and IRR at ₹ 1,22,018, 1.89 and 24.62 per cent respectively at 14 per cent discount rate.

Hugar *et al.* (1991) worked out the NPW, BCR, IRR and pay-back period to know the economic feasibility of guava cultivation. The net present worth during the life period of the orchard worked out to be ₹ 7,38,042 per hectare. The BCR, IRR and pay-back period were found to be 3.88, 57.82 per cent and 6 years respectively. Since B-C ratio was more than unity and IRR was higher than the prevailing bank rate (14%), the scientific cultivation of guava appeared to be strongly viable.

Jaganathan (1992) in his study on economic analysis of coconut farming in Annaimalai Block of Coimbatore district of Tamil Nadu

indicated that the BCR at 12 per cent discount rate was 1.42 without intercropping and 2.18 with intercropping. NPV was found to be ₹ 23,750 in case of gardens without intercropping and the same was ₹ 66,717 in case of gardens with intercropping. The IRR was 25.68 per cent.

Naik *et al*. (1992) in their study on economic evaluation of investment in cashew orchard worked out NPV and BCR as ₹ 86,424, ₹ 72,332 and 2.37, 1.89 at 11 and 14 per cent discount rates respectively.

Wani *et al*. (1994) while studying the economic viability of apple orchards in Kashmir worked out NPV and B-C ratio at 12 per cent discount rate. The calculated NPV was ₹ 53,417.14 per hectare and the B-C ratio, 2.29. They calculated IRR at 26 per cent. The pay-back period worked out to be 14 years.

Lavanya (1996) observed that a pay back period of 6 years, BC ratio of 2.17, a positive and high net present value of ₹ 88,779.08 and internal rate of return of 42.77 per cent indicates worthiness of investments on acid lime orchards.

Usharani (1996) assessed the economic feasibility of investment in mango orchards. Her study revealed that the calculated NPV, BC ratio and annuity even at a high discount rate of 24 per cent were ₹ 15,712.54, 1.525 and ₹ 3771.70 respectively. IRR stood at 38.96 per cent.

Vandana *et al*. (1996) in her study on acid lime, discounted costs and returns at 10, 12, 15 and 20 per cent. The payback period was worked out to be 6 years, NPW was found to be ₹ 1,34,441.74, ₹ 1,06,609.92, ₹ 75,970.06 and ₹ 43,607.40 at 10,12,15 and 20 per cent discount rates respectively. BC ratio was found to be 1.91, 1.85, 1.75 and 1.58 at 10,12,15 and 20 per cent discount rates respectively. The IRR was estimated to be 39.41 per cent.

Korikanthimath *et al.* (1998) carried out a study for 4 years (1990-91 to 1993-94) on mixed cropping of cardamom, pepper and coorg mandarin with robusta coffee which revealed that the NPW and BCR were higher by 3.55 and 1.56 times respectively in mixed cropping over monocropping.

Murthy (1999) while studying the economics of coconut cultivators found out NPV, BCR and IRR as ₹ 22,633.68, 1.38 and 20.03 per cent respectively.

Remold (2000) in his study on cost-benefit analysis of rainfed coconut observed the annuity value (at 13%) and benefit cost ratio of rainfed coconut as ₹ 28,469 and 1:1.01 respectively.

Chinnappa (2002) in his techno economic appraisal of arecanut plantation in non-traditional areas found that the net present worth (NPW) was positive indicating financial viability of investment on arecanut. The benefit-cost ratios were in the order of 1.56 and 2.03 indicating that each rupee of investment made in arecanut would bring a gross income of ₹ 1.56 for command area and ₹ 2.03 for non-command area. The internal rate of return was 26.31 and 34.35 for command and non-command areas respectively.

Khunt *et al*. (2003) examined economic feasibility of investment on mature and tender coconut gardens. The positive net present value (₹ 2,60,000) at 10 per cent discount rate, the higher value of benefit-cost ratio (2.72) and higher value of IRR (41.5%) indicated the financial soundness of the investment on mature nut orchard. The NPV, BCR and IRR were ₹ 2,50,166, 2.08 and 30.10 per cent respectively in the case of tender nut orchard.

Bastine *et al*. (2004) in their study on capital productivity of coconut showed favourable figures for net present value (₹ 5,286.31) and benefit-cost ratio (1.02). The internal rate of returns was worked out to be 7.26 as against an opportunity cost of 7 per cent.

Sharma *et al*. (2006) examined the economic feasibility of mango orchards and found net present value, benefit-cost ratio and internal rate of return at ₹ 1,10,165, 1:3 and 25 per cent respectively.

Thamban *et al.* (2006) revealed that the benefit-cost ratio ranged from 1.32 on marginal farms to 1.7 on large farms in the cultivation of coconut with drip irrigation system. In the case of coconut cultivation with basin irrigation, it varied between 1.29 on marginal farms and 1.63 on large farms. Similarly net present worth ranged from ₹ 49,087 on marginal farms to ₹ 1,32,684 on large farms with basin irrigation and the same was ₹ 52,127 on small and 1,40,232 on large with drip irrigation.

Kumaran (2007) studied the economics of production and value addition of coconut in Pondicherry region. The results indicated that the net present worth was as high as ₹ 2,44,715.80 at 10.0 per cent and ₹ 37,137.90 at 20.0 per cent. The IRR was calculated at 29.20 per cent. All the measures indicated the economic viability of coconut cultivation.

The study of Varghese (2007) on economics of cardmom cultivation in Kerala revealed that the cost of cultivation was significantly high. If rental value of land was included in the cost of cultivation, the net present value turned negative, the benefit-cost ratio became less than one and internal rate of returns 6 per cent. This implied that cardamom cultivation was unprofitable in Kerala.

Gangwar *et al*. (2008) in their study on economic evaluation of peach cultivation in North Indian Plains found that the internal rate of return varied from 20.98 per cent to 23.8 per cent depending upon the size of the orchard. The net present value, benefit-cost ratio and internal rate of return were worked out to be ₹ 44,807, 1.68 and 22.2 respectively for the overall category of orchards at 12 per cent discount rate.

Chinnappa and Nagaraja (2009) in their study on the establishment and maintenance of arecanut plantations under different water management regimes revealed that the investment on arecanut with drip irrigation is economically feasible even without government subsidies.

Hassan (2010) stated that arecanut cultivation was found to be economically viable even at higher discount rate of 24 per cent. The net present worth, benefit-cost ratio were ₹ 71,810.82 and 1.87 respectively at a discount rate of 24 per cent. The internal rate of return was found to be 40 per cent.

Kumar *et al.* (2011) in their study on investment pattern and maintenance cost in pomegranate orchards revealed that the net present values were positive and of higher magnitude, indicating worthwhileness of investment. The internal rate of return was found to be in the range of 57.59 per cent which was much higher than the cost of capital (9.5%).

The capital productivity analysis made by Ramanan (2012) showed favourable figures for net present value (₹ 1,55,864.5) and benefit-cost ratio (1.33) and internal rate of return (24.76). The payback period worked out to be 2.25 years. It indicates that the investment made in a vineyard would be obtained within 2.25 years.

Manasa Veena (2013) in her study revealed that the net present value, benefit-cost ratio were ₹ 32,449.71 and ₹ 67,531.15, 1.54 and 2.77 on surface and drip irrigated farms respectively at a higher discount rate of 24 per cent.

Gondalia *et al.* (2014) carried out a study on economic evaluation of investment on aonla in Gujarat. It was found that the establishment of aonla orchards involved high investment but returns also high after third year. NPV, BCR, IRR and PBR were found to be ₹ 6,52,652, 5.25, 65.03 per cent and 55 months respectively at 10 per cent discount rate. Annual net realization was ₹ 55,965 per ha at early bearing stage and ₹ 86,567 per ha at mature bearing stage of orchard.

Jaggaiah (2015) estimated NPV, B-C ratio, IRR and profitability index at 12, 15 and 20 per cent discount rates, in the production of mango. NPV, B-C ratio and Profitability Index were found to be ₹ 33,043.89, 1.15 and 0.3699 respectively at a higher discount rate of 20 per cent .The IRR was calculated at 23.17 per cent, higher than the borrowed rate of interest of 15 per cent.

Surwase *et al.* (2015) revealed that the per hectare capital investment for establishment of sapota orchard for a period of first 5 years was ₹ 93,609. The annual per hectare cost of cultivation was ₹ 1,20,138. The study also revealed that the investment made in sapota plantation was economically viable with benefit-cost ratio greater than unity (1.87). The net present value was ₹ 4,95,835 and the internal rate of return was higher than that of the prevailing rate of interest.

Singh *et al*. (2016) in their study on economic evaluation of pineapple cultivation in Manipur worked out the net present value, internal rate of return and benefit-cost ration at 8 per cent discount rate as ₹ 24,857.80, 32.53 per cent and 1.23 respectively for overall category of orchard during summer season and ₹ 10,454.44, 67.33 per cent and 1.24 respectively for the above said category during winter season.

2.3 STUDIES ON PRODUCTION AND MARKETING PROBLEMS

Raghupathy *et al.* (1979) found out that the coconut farmers were not generally following the improved cultivation practices for which coconut palm responds positively. Time lag between the investment and returns realized appeared to be the reason for this neglect in coconut production

Agarwal (1981) analysed the problems of agricultural marketing in India and stated that main problems of Indian agricultural marketing are forced sales, presence of large number of middlemen, lack of established regulated markets and malpractices by the middlemen and lack of proper storage facilities *etc*.

Sharma and Thakur (1985) made a study on prospects and problems of fruit industry in Himachal Pradesh. The major production constraints to fruit production identified were difficulty in getting plants, diseases and pests, shortage of inputs, lack of technical knowledge and pollination problems. In marketing, difficulties faced were shortage of packing materials, dominance of traders in the market, high cost of marketing, malpractices resulting in low producer prices, lack of roads and transport, lack of storage space at markets, high rates of commission, and financial problems.

Subramanyam (1986) in his study on horticultural crops identified the production and marketing constraints *viz.,* (i) These crops were highly capital intensive, (ii) the credit advanced by the institutional agencies like commercial banks and co-operative societies was far below the cost of cultivation, and (iii) the high marketing costs were because of lack of infrastructural facilities.

Narasimhappa (1987) reported the marketing problems of coconut as lack of systematic organizational set up for marketing, the exploitation by middlemen and other functionaries and prevalence of malpractices in the markets.

Thakur *et al*. (1987) indicated that among the production problems of fruits the important was supply of critical inputs. Problems like weed control and control of diseases and insects needed the attention of researchers. Grading and packing of citrus need to be modified. There was an urgent need to extend the extension programme in citrus producing areas for disseminating technical knowledge. The vigour of fruits could be better maintained if refrigerated or specialised transportation facilities were made available.

Sikka and Swarup (1989) identified the following problems faced by orchardists *viz.*, lack of proper grading and packing facilities, non-availability of inputs on credit basis and non-availability of labour and material in time at desired place at reasonable price.

Srinivas (1989) in his study observed that coconut farmers were not following recommended package of practices and there were no facilities for providing information regarding the high yielding varieties which led to the farmers to grow low yielding local varieties. He further pointed out that the recommended plant population was not maintained on the coconut gardens.

Reddy and Kumar (1990) studied the problems and prospects in marketing of sweet oranges and revealed that there was lack of storage facilities, poor transport and the absence of a cooperative marketing structure for the product. There were also fluctuations in the price for oranges. The study recommends that steps must be taken to ensure that contracts are honoured and adequate marketing facilities developed in the region.

Ramanchander (1991) opined that the research efforts should be intensified in breeding for root stocks, and scions for resistance to greening and dieback, development of seedless cultivars, development of optimum package of practices for different regions, control of citrus dieback and foot rot.

Sharma (1991) in his study on constraints and problems in citrus cultivation in Himachal Pradesh revealed that the nurseries within the state were not able to cope with the increasing demand for the quality trees in the new orchards and replacement for the old trees. The growers had to buy them from other sources where plants of known parentage with reliable characters were not available. Uncertain weather had become a natural hazard in raising citrus crop though out the region.

Lepcha *et al*. (1993) identified various marketing problems of mandarin oranges as inefficient purchasing, lack of storage facilities, inappropriate

transport and insufficient processing units. These are also the major factors causing sharp fluctuations in prices and large marketing margins.

Lavanya (1996) identified the major problems as lack of credit facilities, non-availability of quality planting material, poor storage facilities, high commission charges in production and marketing of acid lime.

Guha (1998) in her study on tender coconut marketing in Calcutta identified marketing problems *viz.*, lack of space for unloading of tender coconuts and inadequacy of finance.

Murthy (1999) identified the production and marketing problems of coconut *viz.,* non-application of fertilizers and plant protection chemicals, lack of proper credit facilities, inadequate transport and storage facilities, forced sales due to distant regulated market *etc*.

Non availability of labour and machinery, high wage rate, high cost of fertilizers and pesticides, frequent failures in power supply, lack of knowledge of package of practices were the various problems identified by Sivanarayana (2000) in the production of arecanut.

Chowdhury (2002) in his study on problems and prospects of coconut cultivation in Assam identified the following constraints *viz.,* 1. Lack of awarenesss of the farmers on recent developments in crop protection and cropping systems. 2. Lack of quality planting material. 3. lack of proper management practices and. 4. Attack of pests and diseases

Sit and Ghosh (2005) identified the following constraints associated with arecanut cultivation in Sub Himalayan Terrai region of West Bengal (1) cultivation of poor yielding cultivars (2) improper planting material (3) inappropriate spacing (4) inadequate fertilizer application (5) inadequate irrigation (6) pests mainly white grub.

Chinnappa and Nagaraja (2009) reported that higher transportation cost on the one hand and lack of transportation facilities on the other hand were the major problems confronting the arecanut growers.

Maske and Jain (2011) conducted a study on the constraints in production and marketing of papaya in Raipur district of Chhattisghar. They reported that the problem of pests and diseases was reported by 77.27 per cent of farmers. 75 per cent of farmers felt a lack of improved varieties as a problem. Scarcity of labour during the peak season was a problem for 70 per cent of papaya growers. Lack of processing industries based on papaya, storage facilities and regulated markets were the major marketing problems expressed by all the sample farmers.

Sudharshan (2012) reported that pests and diseases, inadequate irrigation facility and lack of timely transportation were the problems faced by the majority of pomegranate growers. Lack of technical know-how and lack of storage facilities were the other problems reported by 90 per cent of pomegranate growers.

Sain *et al*. (2013) revealed that aberrant weather conditions, non-availability of good seedlings and lack of technical knowledge were the major problems in the production of guava. Problems faced in marketing were lack of support price, lack of market organization and non-availability of processing facilities. The study emphasized the need to develop the proper marketing and processing facilities before its cultivation is popularized on a large scale in the state.

Hemambara *et al*. (2014) in their study on production and marketing problems of papaya growers in North Karnataka reported non-availability of genuine plant material and high incidence of viral diseases as the major problems faced by the farmers. Poor road conditions, high commission charges and non-availability of market information were the problems in the marketing of papaya as per the opinion of entire sample farmers.

Bhat *et al*. (2015) revealed that the orchardists faced several constraints in the cultivation of citrus fruit in Jammu region. They were lack of finance and credit facilities, inadequate irrigation facilities, non-availability of good quality seedlings and lack of latest technical knowledge. In the process of marketing, lack of processing units and marketing societies were the major constraints as expressed by almost all the respondents. Lack of remunerative price for the produce, unorganized marketing, less demand for fruits, lack of market information, malpractices were the other major problems expressed by citrus orchardists.

Chapter ~ III

Material and Methods

Chapter – III

MATERIAL AND METHODS

This chapter presents the procedural details in selection of sample, mode of data collection and analytical techniques employed in attaining the stated objectives of the study. The contents of this chapter are presented under the following heads:

3.1 Sampling design

3.2 Collection of data

3.3 Cost structure

3.4 Methods of computation

3.5 Tools of analysis

3.1 SAMPLING DESIGN

Three stage purposive-cum-random sampling technique was adopted to select the ultimate sample.

3.1.1 Selection of the District

Nellore district was purposively selected for the present study as it has the highest area under acid lime orchards (21,128 ha) contributing 50 per cent of total production (3,16,920 tonnes) in Andhra Pradesh. Gudur market of this district is the biggest acid lime market in India.

3.1.2 Selection of Mandals

Out of 46 mandals in Nellore district, four mandals namely Rapur, Kaluvayi, Chejerla and Podalkur that ranked first, second, third and fourth under acid lime area were purposively selected.

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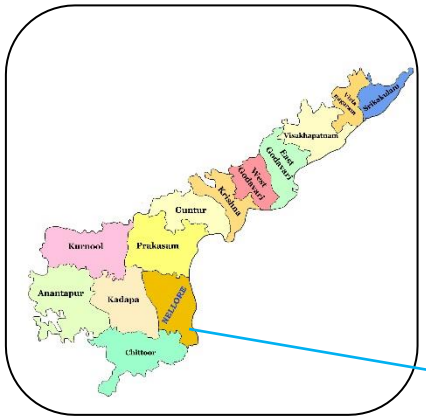

NELLORE DISTRICT MAP

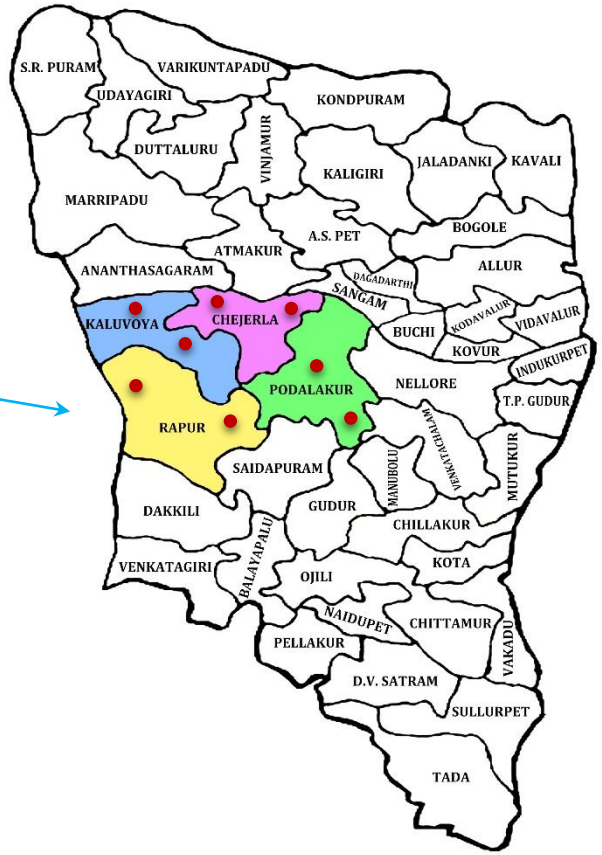

Fig. 3.1. District map of Nellore

3.1.3 Selection of Villages

From the selected mandals, a list of villages growing both balaji and local varieties of acid lime were arranged in the descending order of acerage. The first two villages from each mandal with highest area under selected varieties were chosen for a detailed study. The selected villages were Thumayi, Gundurupalli, Lingampalli, Chittepalli, Kakivoya, Billupadu, Chinthalathmakuru and Chintalapalem.

3.1.4 Selection of Acid lime Orchardists

The list of all acid lime growers from the selected villages was obtained from their respective village records. From each of the selected villages, five orchardists each from balaji and local varieties were selected at random. Thus fourty farmers in each variety constituted the sample of the study. The total number of acid lime orchardists selected for the purpose of the study was 80.

Table 3.1. Sample size of selected farmers

Mandals and Villages	Balaji variety	Local variety	Total
Rapur			
Thumayi	5	5	10
Gundurupalli	5	5	10
Podhalakur			
Lingampalli	5	5	10
Chittepalli	5	5	10
Chejerla			
Kakivoya	5	5	10
Billupadu	5	5	10
Kaluvoya			
Chinthalathmallur	5	5	10
Chintalapalem	5	5	10
Total	**40**	**40**	**80**

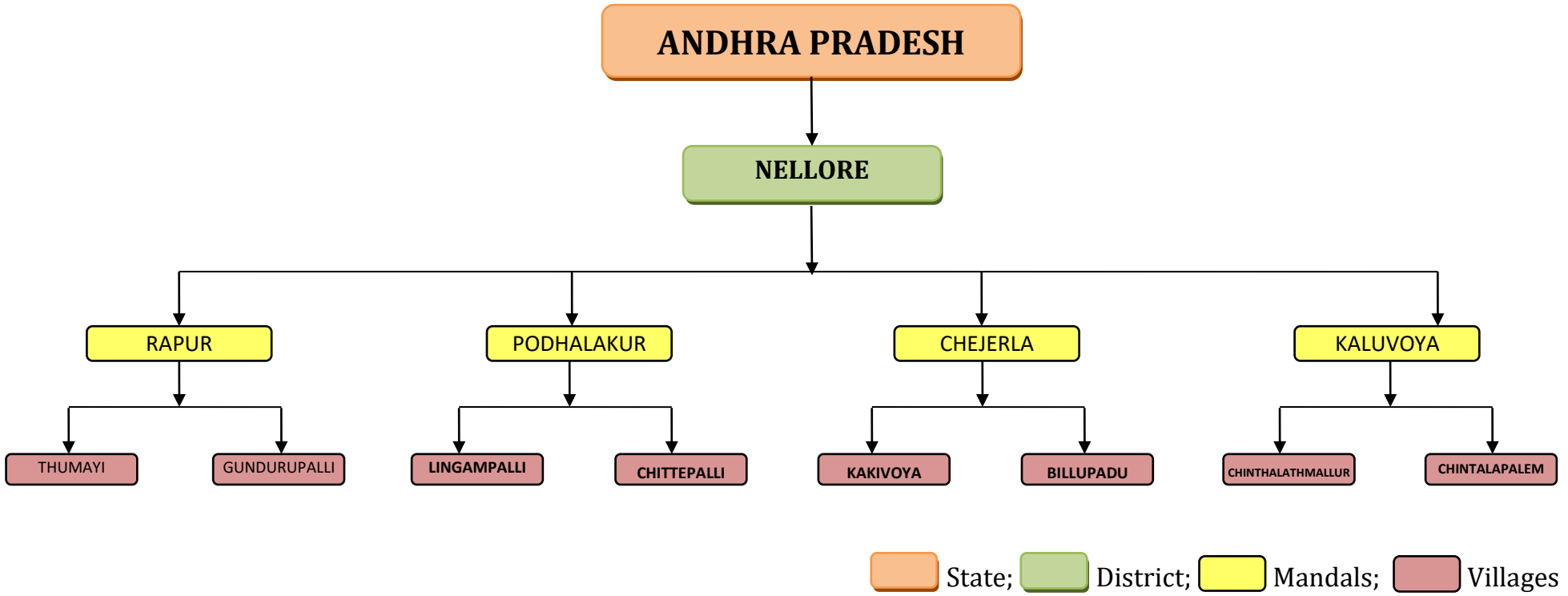

Fig. 3.2. Chart showing the sampling technique

3.2 COLLECTION OF DATA

The primary data pertaining to the production aspects of acid lime were collected with the help of a specially designed pre-tested schedule by personal interview and presented at current prices (2015-16) to estimate costs and returns. An opinion survey was also carried out to identify various production and marketing problems of acid lime. The respondents included in this survey apart from farmers were officials of the Department of Agriculture.

3.3 COST STRUCTURE OF ACID LIME

Acid lime is a perennial crop with an economic life span of 30 years (Local variety) and 20 years (Balaji variety) which starts yielding from 4th year onwards. Balaji variety of acid lime was introduced in the year 2002 though the study area was well known for the cultivation of acid lime of local variety since a long time. The data on the technical coefficients of balaji variety were available only for 15 years. Hence, an economic analysis in the present study was conducted for both local and balaji varieties for 15 years period only to facilitate comparison between the two varieties of acid lime. The costs incurred can be classified into two categories *viz.,*

i. Establishment Costs and

ii. Maintenance Costs

(i) Establishment Costs

The establishment costs included all the expenditure incurred during pre-bearing period (first three years) for establishment of acid lime orchard. Items like land preparation, digging of pits and filling, cost of plant material, manures, fertilizers, plant protection chemicals, expenditure incurred on different farm operations, *viz.,* fencing, weeding, laying of irrigation channels, irrigation *etc.* were considered as establishment costs.

(ii) Maintenance Costs

Expenses incurred on input services like human labour utilized for clearing of basins, weeding, application of manures and fertilizers, irrigation, channel maintenance, services of machinery and on material inputs *viz.*, manures, fertilizers, plant protection chemicals *etc*. were regarded as maintenance costs from 4th year onwards till the end of its economic life period.

3.4 METHODS OF COMPUTATION

The economic analysis of production of acid lime requires proper estimation of the cost of inputs, input services and the valuation of output. The detailed procedure followed in computing the production costs of acid lime is described below.

3.4.1 Human Labour

Actual days worked in performing various cultural operations in the establishment and maintenance of acid lime orchard were recorded separately for male, female, family and hired labour. The womandays were converted into man equivalent days by assigning a ratio of 1.5 womandays equivalent to one man-equivalent day. Human labour was quantified in terms of productive man-work units (usually about 8 hours of productive work). Family labour was valued at the prevailing wage rates of casual labour engaged for similar operations in the study area.

3.4.2 Machine Power

Tractor services both owned and hired were charged at the prevailing rates in the locality per an hour of work.

3.4.3 Plant Material

The plant material was evaluated at the actual price paid plus transportation charges if any.

3.4.4 Farm Yard Manure (FYM)

The cost of manure per tonne was calculated on the basis of prevailing market rate both for purchased and farm produced.

3.4.5 Fertilizers and Plant Protection Chemicals

Market price formed the basis to estimate the cost of monetary inputs like fertilizers and plant protection chemicals.

3.4.6 Interest on Working Capital

It was calculated at the rate of 12 per cent per annum at which commercial banks in the study area were lending loans for crops.

3.4.7 Interest on Fixed Capital

It was calculated at the rate of 8 per cent per annum as the fixed deposits in commercial banks would fetch this rate of interest. Since rental value of owned land was considered, land value was excluded from fixed capital.

3.4.8 Depreciation

Annual amount of depreciation on each working asset owned by the farmer was computed following the straight line method. Later, it was apportioned based on acreage under acid lime.

3.4.9 Land Revenue

Actual amount paid by the orchardist towards land revenue was taken into account.

3.4.10 Rental Value of Owned Land

Actual amount paid by the tenant cultivator to the landlord for the other crops grown on irrigated dry land was considered as rent for acid lime orchards.

3.4.11 Annual Share of Establishment Cost

The total expenditure incurred during pre-bearing period of the orchard was spread over the rest of the economic life period to get the annual share of establishment.

3.5 TOOLS OF ANALYSIS

Conventional analysis and discounted cash flow techniques were used to analyze the data and arrive at valid conclusions. For finding out costs and returns, simple arithmetic averages and percentages were worked out. The process of discounting was used to obtain net present worth, benefit-cost ratio and the internal rate of return.

3.5.1 Conventional Analysis

It was used to arrive at labour and material input requirements, costs and returns *etc*.

3.5.2 Project Evaluation Techniques

In case of perennial crops, for the capital invested now, the benefit would be realized in future for over a period of time. Discounted cash flow measures were used to evaluate the profitability of investment in acid lime orchards. The discounted cash flow method of evaluating long term projects is a process of finding the present worth of the amount received or paid in the future. This technique has an advantage that future cash flows are reduced to a single sum at one specific point of time and this facilitated comparison between alternative investment choices, if any. Depreciation, rental value of owned land, interest on working capital and fixed capital were excluded while estimating the stream of costs over the economic life period of acid lime orchards. The discounted cash flow measures used in the analysis were net present worth, benefit-cost ratio and internal rate of return. The costs and return were discounted by using the formula.

$$P = \frac{F}{(1+i)^n}$$

where,

P = Present worth of future amount

F = Future amount

i = Rate of interest

n = Period

3.5.2.1 Net present worth (NPW)

It is also known as net present value. The NPW method is a process of calculating the present value of cash flows (inflows and outflows) of an investment proposal, using the cost of capital at the appropriate discounting rate and finding out the net present worth by subtracting the present value of cash out flows from the present value of cash inflows. The selection criterion of the project depends on the positive value of net present worth, when discounted at the opportunity cost of capital. The NPW of the project is estimated using the formula.

$$NPW = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}$$

where,

B_t = Benefit in t^{th} year

C_t = Cost in t^{th} year

t = 1, 2, 3,……n

n = Number of years

i = Discount rate

3.5.2.2 Benefit-cost ratio (B-C ratio)

Yet another time adjusted method of evaluating the investment proposal is the benefit-cost ratio or Profitability Index. It is the ratio of the present value of cash inflows to the present value of cash outflows. The common procedure of selecting the project is to choose the projects having the B-C ratio of more than one where cash inflows and outflows are discounted at opportunity cost of capital. This ratio was arrived by using the formula.

$$\text{Benefit-Cost Ratio} = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+i)^t}}$$

where,

B_t = Benefit in t^{th} year

C_t = Cost in t^{th} year

t = 1, 2, 3,……n

n = Number of years

i = Discount rate

3.5.2.3 Internal rate of return (IRR)

The internal rate of return can be defined as that rate which equates the present value of cash inflows with the present value of cash outflows of an investment. In other words, it is the rate at which the net present value of the investment is zero. It is called internal rate because it depends solely on the outlay and proceeds associated with the project and not on any rates determined outside the investment. IRR is the maximum interest rate that the project could pay for the resources used if the project is to recover its

investment and operating costs and still breaks even. It is also known as marginal efficiency of capital or yield of an investment or rate of return over cost.

To compute IRR, select any discount rate to estimate the present value of cash inflows. If the calculated present value of the expected cash inflow is lower than the present value of cash outflows, a lower rate should be tried. On the other hand, a higher value should be tried if the present value of inflows is higher than the present value of outflows. This process will be repeated till the net present value becomes zero. The equation for finding IRR is as follows.

$$\text{IRR} = \text{Lower discount rate} + \text{difference between two discount rates} \left[\frac{\text{Present worth of the cash flows at the lower discount rate}}{\text{Absolute difference between the present worth of the cash flows at the two discount rates}} \right]$$

3.5.3 Sensitivity Analysis

It involves changing one or more values in net present worth equation and recalculating the NPW. This analysis provides better insight into the profitability of investment.

Chapter ~ IV

Results & Discussion

Chapter – IV

RESULTS AND DISCUSSION

In this chapter an attempt is made to present the results obtained from the present study with relevant discussion and explanation. For convenience, this chapter is divided into the following sub-heads.

4.1 Socio-economic characteristics of selected respondents

4.2 Resource services and resources utilization on acid lime orchards

4.3 Cost structure on acid lime orchards

4.4 Returns from acid lime orchards

4.5 Economic viability of acid lime orchards

4.5 Problems of production and marketing of acid lime.

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF SELECTED RESPONDENTS

This provides a comprehensive understanding of the composition of farm family, availability of family labour, size of holding and pattern of assets of the selected respondents.

4.1.1 Family Size and Composition

The composition of the family in respect of male, female, children and farm family labour availability is presented in Table 4.1. It is observed from the table that the family size on an average ranged from 5.02 members on the farms of balaji variety to 5.22 members on the farms of local variety. The composition of family with respect to male and female showed that they were more on the farms of balaji variety. However, the number of children were more on the farms of local variety compared to the farms growing balaji variety.

Table 4.1. Family composition and family labour contribution on selected farms

S. No.	Particulars	Balaji variety farms	Local variety farms
1.	**Family composition**		
a.	Male	1.67 (33.27)	1.50 (28.74)
b.	Female	1.70 (33.87)	1.52 (29.12)
c.	Children	1.65 (32.86)	2.20 (42.14)
	Total	**5.02 (100.00)**	**5.22 (100.00)**
2.	**Farm family workers**		
a.	Male	1.67 (69.00)	1.47 (62.02)
b.	Female	0.75 (31.00)	0.90 (37.98)
	Total	**2.42 (100.00)**	**2.37 (100.00)**

Note: Figures in parentheses indicate percentages to total

It is also evident from Table 4.1 that the participation of family members in farming was more or less the same on both the categories of farms. On the whole, the family workers varied from 2.37 members on the farms of local variety to 2.42 members on the farms of balaji variety.

4.1.2 Size of the Farm

Farm size is one of the important factors that influence the magnitude and efficiency of production and income for the farm families. As seen from Table 4.2, the average farm size was 3.5 hectares on the farms of balaji variety and 5.5 hectares on the farms of local variety. Of the 3.5 hectares on the farms growing balaji variety, the share of irrigated dry land and wet land was 2.29 ha (65.42%) and 1.21 ha (34.58%) respectively. Similarly, of the 5.5 ha of the farms growing local variety, the share of irrigated dry land was 4.96 ha accounting for 90.19 per cent of the total holding. The area under wet land on the farms of local variety was 0.54 ha accounting for 9.81 per cent of the total holding. Acid lime varieties *viz.,* balaji and local which were the selected enterprises for an economic analysis occupied 2.17 and 2.05 ha of irrigated dry land and thus accounting for 62 and 37.28 per cent of the total land holding respectively.

From the above analysis, it is clear that the size of the land holding on the farms of local variety was more than that of the farms of balaji variety. The percentage of irrigated dry land to total holding was higher on the farms of local variety (90.19%) compared to the farms of balaji variety (65.42%). On the contrary, the proportion of wet land in total holding was more in the case of balaji variety farms (34.58%) compared to local variety farms (9.81%). It is important to note that the farmers in the study area established acid lime orchards mainly on dry lands, but irrigation is provided through bore wells.

Table 4.2. Average size of land holding of the sample farmers

(Area in hectares)

S. No.	Particulars	Balaji variety farms	Local variety farms
1.	Irrigated dry land	2.29 (65.42)	4.96 (90.19)
2.	Wet land	1.21 (34.58)	0.54 (9.81)
3.	Total holding	3.50 (100.00)	5.50 (100.00)
4.	Area under acid lime	2.17 (62.00)	2.05 (37.28)

Note: Figures in parentheses indicate percentages to the total

4.1.3 Farm Inventory

The value and composition of farm assets reflect economic background of acid lime orchardists. The particulars of farm assets per hectare are presented in Table 4.3. A perusal of the results indicates that the per hectare total value of assets including land ranged from ₹ 1,057,445 on local variety farms to ₹ 1,130,916 on the farms of balaji variety. The land has taken lion share in the total value of farm assets. It was 94.57 per cent for local variety farms which was more than that of balaji variety farms (88.42%). An assessment of value of assets excluding land was made. The value of farm assets excluding land on the farms of balaji and local varieties was ₹ 1,30,916 (11.58%) and ₹ 57,445 (5.43%) per hectare respectively. As regards magnitude and pattern of value of assets, the value of livestock occupied second place claiming 8.84 per cent and 2.85 per cent of the value of total assets on the farms of balaji and local varieties respectively. It is observed that the orchardists of balaji variety maintained more number of milch cattle than the growers of local variety. Hence, there was a marked difference in the value of livestock in the total value of farm assets between the two categories of farms. Next in the order were value of machinery and equipment and value of farm buildings accounting for 2.58 and 0.16 and 2.49 and 0.09 per cent of total value of assets on the farms of balaji and local varieties respectively.

4.2 RESOURCE SERVICES AND RESOURCES UTILIZATION ON ACID LIME ORCHARDS.

Production of acid lime requires resource services like human labour, cattle labour and machinery as well as material inputs *viz.,* planting material, fertilizers, farm yard manure, plant protection chemicals *etc*. The value of these resource services and material inputs forms cost structure of acid lime cultivation.

Table 4.3. Asset structure of sample farms

(Rupees per hectare)

S. No	Particulars	Balaji variety farms		Local variety farms	
		Value	**%**	**Value**	**%**
1.	Value of land	1000000	88.42	1000000	94.57
	a. Value of wet land	750000	66.32	750000	70.93
	b. Value of irrigated dry land	250000	22.10	250000	23.64
2.	Non-land assets				
	a. Value of farm buildings	1750	0.16	1020	0.09
	b. Value of livestock	100000	8.84	30150	2.85
	c. Value of machinery and implements	29166	2.58	26275	2.49
3.	Value of assets				
	a. With land	1130916	100.00	1057445	100.00
	b. Without land	130916	11.58	57445	5.43

4.2.1 Human Labour Utilization per Hectare on Acid Lime Orchards

Human labour is one of the factors of production and also a major cost component that influences the cultivation of any farm enterprise. Successful completion of every agricultural operation requires some amount of human resource. The human labour use depends on the nature and size of the enterprise. Keeping this in view, an attempt has been made to examine the magnitude and pattern of labour use in acid lime cultivation.

4.2.1.1 Human labour utilization on acid lime orchards during 1-3 years (pre-bearing period)

The operation wise human labour use in the cultivation of acid lime during the pre-bearing period is presented in Table 4.4. The total labour utilized for the establishment of acid lime orchards of balaji and local varieties during the first year was 161.50 mandays and 159.05 mandays per hectare respectively.

It is noted that the fencing was the most labour absorbing operation requiring 30 mandays each per hectare accounting for 18.57 and 18.87 per cent on the farms of balaji and local varieties respectively. Human labour was required for cutting the thorny bushes and planting.

It is observed that weeding was the next important labour absorbing operation requiring 28 mandays per hectare each on the farms of balaji and local varieties accounting for 17.37 per cent and 17.61 per cent of the total labour. Weeding in acid lime orchards was done manually and hence orchardists employed greater mandays of human labour for better establishment and growth of acid lime plants. Weeding involves digging of earth around the plant and preparation of basins for irrigation.

Land preparation was the third most important labour consuming operation and needed 25 mandays each on the farms of balaji and local varieties. This accounted for 15.47 per cent and 15.72 per cent of total labour use on the farms of balaji and local varieties respectively during the first year. Land preparation involves removal of stubbles.

Irrigation ranked fourth in the labour utilization during the first year of establishment of acid lime orchards. This operation needed 20 mandays and 15 mandays per hectare on the farms of balaji and local varieties respectively. This operation accounted for 12.38 per cent and 9.43 per cent on the above said categories of farms. The acid lime sampling require frequent irrigation during the first 15-20 days after planting. They are pot watered daily by using women labour for better establishment of the samplings and during the later stages they are irrigated through field channels.

About 210 to 225 pits are dug as per the density of planting adopted by the farmers. The pits of dimension $1^1 \times 1^1 \times 1^1$ were dug during the first year and filled with soil and farm yard manure. This operation employed 15 mandays per hectare on balaji variety farms and 14 mandays per hectare on local variety farms.

The other important operation was planting. Planting consisting of placing the plant in the centre of pit and filling it with soil and pressing the soil around the plant. Planting required 15 mandays each on balaji and local variety farms.

Orchardists of balaji and local varieties of acid lime employed 13 (8.04%), and 15 mandays (9.44%) per hectare respectively for the application of manures and fertilizers. The other operations on which human labour was used were marking of lines (8 and 10 mandays each on balaji and local varieties) and application of plant protection chemicals (7.5 and 7.0 mandays on balaji and local varieties respectively).

An examination of labour use during 2nd and 3rd year revealed that it was almost uniform use of the human labour for operations *viz.*, irrigation, clearing of basins, fence maintenance and plant protection on the farms of balaji and local varieties.

Clearing of basins, laying of irrigation channels, fence maintenance, weeding, application of manures and fertilizers and irrigation were the major labour absorbing operations requiring 40, 40, 30, 28, 24 and 20 mandays during 2nd year and 40, 50, 30, 53, 25 and 20 mandays per hectare during 3rd year on the farms of balaji variety. These operations together accounted for more than 80 per cent of the total labour use during 2nd and 3rd year of establishment of the balaji variety orchards.

On the farms of local variety, laying of irrigation channels, clearing of basins, weeding, fence maintenance, application of manures and fertilizers and irrigation were the major labour absorbing operations with 37.5, 30, 28, 30, 19.5 and 15 mandays per hectare during 2nd year and 45, 30, 40, 30, 27.5 and 15 mandays per hectare during 3rd year of establishment of orchard. These five operations together accounted for 83.62 and 81.84 per cent of the total labour used during 2nd and 3rd year respectively.

The total labour requirement was 189.5, 225.5 and 168, 195.5 mandays per hectare on the farms of balaji and local varieties during 2nd and 3rd year respectively.

The total labour requirement during pre-bearing period (1-3 years) was 576.5 and 522.55 mandays per hectare on the acid lime orchards of balaji and local varieties respectively. Out of which 499.62 mandays came from hired labour and 76.88 mandays from the family labour on the farms of balaji variety. On the farms of local variety, hired labour and owned labour accounted for 85.52 and 14.48 per cent respectively.

Table 4.4. Operation-wise human labour utilization in mandays per hectare of acid lime orchards: 1st – 3rd year (pre- bearing period)

S. No.	Operations	Balaji variety farms (Years)				Local variety farms (Years)			
		1	2	3	Total	1	2	3	Total
1.	Land preparation	25 (15.47)	-	-	25 (4.34)	25 (15.72)	-	-	25 (4.79)
2.	Marking of lines	8 (4.95)	-	-	8 (1.39)	10 (6.28)	-	-	10 (1.92)
3.	Digging of pits	15 (9.29)	-	-	15 (2.60)	14 (8.81)	-	-	14 (2.68)
4.	Planting	15 (9.29)	-	-	15 (2.60)	15 (9.43)	-	-	15 (2.87)
5.	Application of manures and fertilizers	13 (8.04)	24 (12.68)	25 (11.09)	62 (10.76)	15 (9.44)	19.5 (11.62)	27.5 (14.07)	62 (11.87)
	a. Loading & unloading of FYM	5 (3.09)	10 (5.28)	10 (4.43)	25 (4.34)	5 (3.14)	7 (4.17)	10 (5.12)	22 (4.21)
	b. Manuring	6 (3.71)	12 (6.34)	12 (5.32)	30 (5.20)	7.5 (4.72)	10 (5.96)	15 (7.67)	32.5 (6.22)
	c. Application of fertilizers	2 (1.24)	2 (1.06)	3 (1.34)	7 (1.22)	2.5 (1.58)	2.5 (1.49)	2.5 (1.28)	7.5 (1.44)
6.	Weeding	28 (17.37)	28 (14.78)	53 (23.50)	109 (18.91)	28 (17.61)	28 (16.67)	40 (20.46)	96 (18.37)

Contd…

S. No.	Operations	Balaji variety farms (Years)				Local variety farms (Years)			
		1	2	3	Total	1	2	3	Total
7.	Laying of irrigation channels and maintenance	-	40 (21.10)	50 (22.17)	90 (15.62)	-	37.5 (22.32)	45 (23.01)	82.5 (15.79)
8.	Irrigation	20 (12.38)	20 (10.55)	20 (8.87)	60 (10.40)	15 (9.43)	15 (8.93)	15 (7.67)	45 (8.61)
9.	Clearing of basins	-	40 (21.10)	40 (17.74)	80 (13.87)	-	30 (17.85)	30 (15.35)	60 (11.48)
10.	Fencing/Fence maintenance	30 (18.57)	30 (15.83)	30 (13.30)	90 (15.61)	30 (18.87)	30 (17.85)	30 (15.35)	90 (17.22)
11.	Plant protection	7.5 (4.64)	7.5 (3.96)	7.5 (3.33)	22.5 (3.90)	7 (4.41)	8 (4.76)	8 (4.09)	23 (4.40)
12.	Pruning of branches	-	-	-		-	-	-	
	Total	161.5 (100)	189.5 (100)	225.5 (100)	576.5 (100)	159.05 (100)	168 (100)	195.5 (100)	522.55 (100)
	Owned labour	21.81 (13.50)	22.37 (11.80)	32.70 (14.50)	76.88 (13.34)	23.07 (14.50)	21.68 (12.90)	30.89 (15.80)	75.64 (14.48)
	Hired labour	139.69 (86.50)	167.13 (88.20)	192.80 (85.50)	499.62 (86.66)	135.98 (85.50)	146.32 (87.10)	164.61 (84.20)	446.91 (85.52)

Note: Figures in parentheses indicate percentages to the total

Acid lime orchardists employed more number of mandays for weeding in the 3rd year compared to previous years. This is attributed to the reason that with the growth of plants the basin area around each plant increases and hence more labour is required for weeding operation. Acid lime growers of both the varieties employed greater proportion of human labour for clearing of basins and maintenance of irrigation channels. The irrigation channels were either damaged or destroyed after every intercultivation with cultivators and harrows and hence channel maintenance was required. Manuring required more number of mandays in 3rd year compared to previous years on both the categories of farms as greater quantities of manure were applied to the acid lime orchards. Large requirement of human labour during the period of establishment in acid lime orchard was also observed in the study conducted by Vandana *et al* (1996) and Lavanya (1996). From the above discussion, it is clear that the total labour used on the farms of local variety (522.55 mandays) was less compared to balaji variety farms (576.5 mandays). This is because of differences in the utilization of human resource for the operations such as clearing of basins, irrigation and weeding.

4.2.1.2 Human labour utilization during bearing-period (4th–15th year)

Details of operation-wise human labour utilization from 4th to 15th year (bearing period) of balaji and local varieties are presented in Tables 4.5 and 4.6. The total human labour employment during the bearing period exhibited increasing trend on both the farms of balaji and local varieties revealing a positive relationship with the age of the orchard during this period. The total human labour was 300.5 and 284.5, 398.47 and 320.75, 395.37 and 330.25, 380.35 and 381.87, 456 and 366.62, 482 and 439.12, 482 and 439.12, 507 and 439.12, 517 and 464.12, 592 and 489.12, 592 and 489.12, 507 and 414.12 mandays per hectare from 4th to 15th year on the orchards of balaji and local varieties respectively. Acid lime orchards come

to bearing from 4th year onwards. Harvesting and pruning of branches were the other operations added to the list of cultural practices performed on acid lime orchards. Watch and ward was necessitated as the trees come to bearing and this item was clubbed with irrigation.

A total of 5594.69 mandays and 4857.83 mandays per hectare were employed on the acid lime orchards of balaji and local varieties respectively to perform all operations from 4th to 15th year. Out of total labour utilization, family labour contribution was 707.75 mandays (12.65%) and 657.58 mandays (13.54%) on the above said categories of farms.

The most labour absorbing operation during bearing period was harvesting which required 1738 mandays and 1172.5 mandays per hectare on balaji and local variety acid lime orchards. This operation accounted for 31.06 per cent and 24.14 per cent of total labour used on the aforesaid varieties of acid lime farms. The labour utilization towards this operation increased from 50 mandays per hectare in 4th year to 250 mandays per hectare in 14th year on balaji variety orchards. While in the case of local variety orchards, it increased from 10 mandays per hectare in 4th year to 175 mandays per hectare in 14th year. The increase in the labour use was due to increased yields with the age of the orchard.

The next important labour absorbing operation was irrigation which required 915 mandays (16.36%) for balaji variety farms and 684 mandays (14.08%) for local variety farms. The human labour requirement for irrigation showed an increasing trend from 20 mandays in 4th year to 95 mandays in 8th year and remained the same upto 15th year on the balaji variety farms. In the case of local variety farms, the human labour requirement increased from 33 mandays in 4th year to 65 mandays in the 7th year and remained constant during the rest of the period. This increase in human labour requirement during bearing period was due to increase in basin area and larger requirement of irrigation water with the rise in age of

the orchards. Acid lime orchards cannot withstand drought for a long time and being a perennial crop once affected by water stress, it may require 2-3 years to regain its normal vigour and yield. The orchards should be irrigated once in 10-15 days. Hence watering the garden assumes greater importance.

Application of manures and fertilizers including loading and unloading of FYM exhibited an increasing trend in human labour requirement from the 4th to 14th year. It amounted to 666.6 mandays on the farms of balaji variety and 776 mandays per hectare on the farms of local variety. This operation accounted for 11.92 per cent and 15.99 per cent of the total labour utilization during the bearing period on the above said varieties of acid lime orchards. This was due to the fact that the greater quantities of farm yard manure were applied to the acid lime orchards during these years which necessiated employment of more number of labour for loading and unloading and application of manures.

Weeding consumed 609 mandays and 573 mandays accounting for 10.89 per cent and 11.79 per cent of the total labour employment during bearing period on balaji and local varieties of acid lime orchards. From 6th year onwards no intercultivation was possible either through cattle labour or tractor power due to constraint on the space between the trees and hence weeding operation had to be undertaken manually. As a result, farmers employed more number of workers for weeding operation to compensate for intercultivation from 6th year onwards. The rise in human labour utilization is due to the increase in basin area which is directly proportional to the circumference of canopy cover of each tree to accommodate more irrigation water.

Clearing of basins was the other operation which required 559 mandays (9.99%) and 427.4 mandays (8.79%) on balaji and local varieties of farms respectively. The requirement of labour for the maintenance of irrigation channel was 163 mandays (2.92%) and 193.12 mandays (3.98%) on the above said varieties of acid lime orchards. Orchardists performed the cultural practice of irrigation channels maintenance upto 7th year of bearing period.

Application of plant protection chemicals was an another important labour consuming operation for which orchardsits of balaji variety employed 326.09 mandays per hectare accounting for 5.82 per cent of the total labour used during bearing period. In the case of local variety, the orchardists used 390.5 mandays (8.04%) for this operation.

Orchardists employed human labour for the maintenance of fence which involve planting the live fence with thorny bushes in the gaps created by the death of the same in the pre-bearing period. This operation required 360 mandays per hectare each on balaji and local variety farms. Pruning of branches is another cultural practice followed by acid lime growers for which they employed 258 mandays (4.62%) and 281 mandays (5.79%) on balaji and local variety farms respectively.

The analysis of human labour utilization during bearing period of acid lime orchards indicated considerable difference in the total human labour requirement and more so for individual operations such as harvesting, irrigation, application of manures and fertilizers and weeding between balaji and local varieties farms. It was also revealed that the major labour absorbing operations were harvesting, irrigation, application of manures and fertilizers and weeding accounting for more than 70 per cent of the total labour used on both the varieties of acid lime orchards. Orchardists of balaji variety engaged more labour than the orchadists of local variety. The reason for this trend was the employment of more labour for harvesting and irrigation by the farmers of balaji variety. The yields from balaji variety were more than that of local variety resulting in employment of more labour for harvesting.

Table 4.5. Operation -wise human labour utilization in mandays per hectare – Balaji variety: 4th – 15th year (Bearing period)

S. No.	Operations	Years												Total
		4	5	6	7	8	9	10	11	12	13	14	15	
1.	Laying of irrigation channels	60 (19.97)	53 (13.31)	50 (12.64)	-	-	-	-	-	-	-	-	-	163 (2.92)
2.	Clearing of basins	60 (19.97)	75 (18.83)	60 (15.18)	60 (15.78)	38 (8.34)	38 (7.89)	38 (7.89)	38 (7.49)	38 (7.43)	38 (6.48)	38 (6.48)	38 (7.49)	559 (9.99)
3.	Application of manures and fertilizers	34 (11.31)	47.6 (11.95)	48.5 (12.28)	48.5 (12.76)	49.5 (10.86)	60.5 (12.54)	60.5 (12.54)	60.5 (11.95)	65.5 (12.80)	65.5 (11.16)	65.5 (11.16)	60.5 (11.95)	666.6 (11.92)
	a. Loading & unloading of FYM	15 (4.99)	20 (5.02)	20 (5.06)	20 (5.26)	20 (4.39)	25 (5.18)	25 (5.18)	25 (4.94)	25 (4.89)	25 (4.26)	25 (4.26)	25 (4.94)	270 (4.83)
	b. Manuring	16 (5.33)	22 (5.53)	22 (5.57)	22 (5.79)	22 (4.82)	28 (5.80)	28 (5.80)	28 (5.53)	33 (6.45)	33 (5.62)	33 (5.62)	28 (5.53)	315 (5.63)
	c. Application of fertilizers	3 (0.99)	5.6 (1.40)	6.5 (1.65)	6.5 (1.71)	7.5 (1.65)	7.5 (1.56)	7.5 (1.56)	7.5 (1.48)	7.5 (1.46)	7.5 (1.28)	7.5 (1.28)	7.5 (1.48)	81.6 (1.46)
4.	Irrigation	20 (6.66)	45 (11.29)	45 (11.39)	45 (11.83)	95 (20.84)	95 (19.70)	95 (19.70)	95 (18.74)	95 (18.56)	95 (16.18)	95 (16.18)	95 (18.74)	915 (16.36)
5.	Weeding	39 (12.97)	50 (12.54)	50 (12.65)	60 (15.78)	60 (13.16)	50 (10.38)	50 (10.38)	50 (9.86)	50 (9.77)	50 (8.52)	50 (8.52)	50 (9.86)	609 (10.89)
6.	Plant protection	7.5 (2.49)	16.87 (4.24)	16.87 (4.26)	16.85 (4.44)	33.5 (7.34)	33.5 (6.95)	33.5 (6.95)	33.5 (6.60)	33.5 (6.53)	33.5 (4.25)	33.5 (4.25)	33.5 (6.60)	326.09 (5.82)
7.	Pruning of branches	-	18 (4.52)	20 (5.06)	20 (5.25)	25 (5.47)	25 (5.18)	25 (5.18)	25 (4.93)	25 (4.88)	25 (5.12)	25 (5.12)	25 (4.93)	258 (4.62)
8.	Fence maintenance	30 (9.99)	30 (7.52)	30 (7.58)	30 (7.88)	30 (6.57)	30 (6.23)	30 (6.23)	30 (5.92)	30 (5.85)	30 (5.12)	30 (5.12)	30 (5.92)	360 (6.42)
9.	Harvesting	50 (16.64)	63 (15.80)	75 (18.96)	100 (26.28)	125 (27.42)	150 (31.13)	150 (31.13)	175 (34.51)	175 (34.18)	250 (42.59)	250 (42.59)	175 (34.51)	1738 (31.06)
	Total	300.5 (100)	398.47 (100)	395.37 (100)	380.35 (100)	456 (100)	482 (100)	482 (100)	507 (100)	517 (100)	592 (100)	592 (100)	507 (100)	5594.69 (100)
	Owned labour	46.58 (15.50)	54.79 (13.75)	49.43 (12.50)	41.46 (10.90)	54.27 (11.90)	50.61 (10.50)	60.25 (12.50)	83.41 (16.45)	73.73 (14.40)	69.27 (11.80)	63.11 (10.75)	60.84 (12.00)	707.75 (12.65)
	Hired labour	253.92 (84.50)	343.68 (86.25)	345.94 (87.50)	338.89 (89.10)	401.73 (88.10)	431.39 (89.50)	421.75 (87.50)	423.59 (83.55)	438.27 (85.60)	517.73 (88.20)	523.89 (89.25)	446.16 (88.00)	4886.94 (87.35)

Note: Figures in parentheses indicate percentages to the total

Table 4.6. Operation-wise human labour utilization in mandays per hectare – Local variety: 4th – 15th year (Bearing period)

S. No.	Operations	Years												Total
		4	5	6	7	8	9	10	11	12	13	14	15	
1.	Laying of irrigation channels	52.5 (18.46)	56.25 (17.54)	56.25 (17.04)	28.12 (7.36)	-	-	-	-	-	-	-	-	193.12 (3.98)
2.	Clearing of basins	45 (15.82)	56.25 (17.54)	45 (13.64)	56.25 (14.73)	28.12 (7.68)	28.12 (6.41))	28.12 (6.41)	28.12 (6.41)	28.12 (6.05)	28.12 (5.75)	28.12 (5.75)	28.12 (6.79)	427.40 (8.79)
3.	Application of manures and fertilizers	38 (13.36)	56 (17.46)	57 (17.28)	57 (14.94)	71 (19.37)	71 (16.18)	71 (16.18)	71 (16.18)	71 (15.31)	71 (14.53)	71 (14.53)	71 (17.15)	776 (15.99)
	a. Loading & unloading of FYM	15 (5.27)	20 (6.24)	20 (6.06)	20 (5.24)	25 (6.82)	25 (5.69)	25 (5.69)	25 (5.69)	25 (5.39)	25 (5.12)	25 (5.12)	25 (6.03)	275 (5.67)
	b. Manuring	20 (7.03)	30 (9.35)	30 (9.09)	30 (7.86)	38 (10.37)	38 (8.66)	38 (8.66)	38 (8.66)	38 (8.19)	38 (7.77)	38 (7.77)	38 (9.18)	414 (8.53)
	c. Application of fertilizers	3 (1.06)	6 (1.87)	7 (2.13)	7 (1.84)	8 (2.18)	8 (1.83)	8 (1.83)	8 (1.83)	8 (1.73)	8 (1.64)	8 (1.64)	8 (1.94)	87 (1.79)
4.	Irrigation	33 (11.60)	33 (10.29)	33 (9.99)	65 (17.02)	65 (17.72)	65 (14.81)	65 (14.81)	65 (14.81)	65 (14.00)	65 (13.29)	65 (13.29)	65 (15.69)	684 (14.08)
5.	Weeding	50 (17.58)	33 (10.29)	40 (12.13)	50 (13.09)	50 (13.63)	50 (11.39)	50 (11.39)	50 (11.39)	50 (10.77)	50 (10.23)	50 (10.23)	50 (12.07)	573 (11.79)
6.	Plant protection	8 (2.81)	11.25 (3.50)	11.25 (3.41)	22.5 (5.89)	22.5 (6.13)	45 (10.24)	45 (10.24)	45 (10.24)	45 (9.69)	45 (9.20)	45 (9.20)	45 (10.87)	390.50 (8.04)
7.	Pruning of branches	18 (6.32)	20 (6.24)	20 (6.07)	23 (6.03)	25 (6.82)	25 (5.69)	25 (5.69)	25 (5.69)	25 (5.38)	25 (5.12)	25 (5.12)	25 (6.03)	281 (5.79)
8.	Fence maintenance	30 (10.54)	30 (9.35)	30 (9.08)	30 (7.86)	30 (8.18)	30 (6.82)	30 (6.82)	30 (6.82)	30 (6.47)	30 (6.12)	30 (6.12)	30 (7.25)	360 (7.40)
9.	Harvesting	10 (3.51)	25 (7.79)	37.5 (11.36)	50 (13.08)	75 (20.47)	125 (28.46)	125 (28.46)	125 (28.46)	150 (32.33)	175 (35.76)	175 (35.76)	100 (24.15)	1172.5 (24.14)
	Total	284.5 (100)	320.75 (100)	330.25 (100)	381.87 (100)	366.62 (100)	439.12 (100)	439.12 (100)	439.12 (100)	464.12 (100)	489.12 (100)	489.12 (100)	414.12 (100)	4857.83 (100)
	Owned labour	46.66 (16.40)	47.64 (14.85)	45.84 (13.88)	45.18 (11.83)	43.38 (11.83)	53.80 (12.25)	76.15 (17.34)	66.27 (15.09)	63.82 (13.75)	57.97 (11.85)	58.06 (11.87)	52.81 (12.75)	657.58 (13.54)
	Hired labour	237.84 (83.60)	273.11 (85.15)	284.41 (86.12)	336.69 (88.17)	323.24 (88.17)	385.32 (87.75)	362.97 (82.66)	372.85 (84.91)	400.30 (86.25)	431.15 (88.15)	431.06 (88.13)	361.31 (87.25)	4200.25 (86.46)

Note: Figures in parentheses indicate percentages to the total

4.2.1.3 Human labour utilization per hectare on acid lime orchards during pre-bearing and bearing periods (1 to 15 years)

The total labour requirement for the cultivation of acid lime orchards stood at 6,171.19 and 5,380.38 mandays per hectare on balaji and local varieties farms respectively. As said earlier harvesting was the operation which absorbed maximum labour. It was 1,738.00 and 1,172.50 mandays per hectare accounting for 28.17 per cent and 21.79 per cent on the aforesaid categories of farms respectively. The other major labour absorbing operations were irrigation (975 and 729 mandays), application of manures and fertilizers (728.6 and 838 mandays) and weeding (718 and 669 mandays) on balaji and local varieties orchards. Clearing of basins and fence maintenance required 639 and 450, 487.4 and 450 mandays per hectare on the above said varieties of acid lime orchards. These six operations accounted for more than 80 per cent of total labour used for the 15 year period on both the categories of orchards.

4.2.2 Machine Power Utilization in Acid Lime Orchards during Pre-bearing and Bearing Periods (4^{th} to 15^{th} Year)

It is evident from Tables 4.8 and 4.9 that the machine power was used for land preparation, intercultivation and transportation of material inputs. Usage of machine power was not possible for intercultivation after 6^{th} year due to lack of space between the trees.

Orchardists of balaji and local varieties used 229.92 and 218.5 hours of machine power per hectare respectively for the entire period of 15 years. Transportation utilized maximum machine labour accounting for 70.65 per cent and 66.25 per cent of the total machinery power used on the farms of balaji and local varieties respectively. Intercultivation was the next important operation for which 57.5 hours and 62.5 hours were employed by the growers of aforesaid categories of farms. In the first year of establishment

Table 4.7. Operation -wise human labour utilization in mandays per hectare of acid lime orchards for 15 years

S. No.	Operations	Balaji variety farms			Local variety farms		
		Pre-bearing (1-3 yrs)	Bearing (4-15 yrs)	Total	Pre-bearing (1-3 yrs)	Bearing (4-15 yrs)	Total
1.	Land preparation	25 (4.34)	-	25 (0.41)	25 (4.79)	-	25 (0.47)
2.	Marking of lines	8 (1.39)	-	8 (0.13)	10 (1.92)	-	10 (0.18)
3.	Digging of pits	15 (2.60)	-	15 (0.24)	14 (2.68)	-	14 (0.26)
4.	Planting	15 (2.60)	-	15 (0.24)	15 (2.87)	-	15 (0.28)
5.	Application of manures and fertilizers	62 (10.76)	666.6 (11.92)	728.6 (11.81)	62 (11.87)	776 (15.99)	838 (15.57)
	a. Loading & unloading of FYM	25 (4.34)	270 (4.83)	295 (4.78)	22 (4.21)	275 (5.67)	297 (5.52)
	b. Manuring	30 (5.20)	315 (5.63)	345 (5.59)	32.5 (6.22)	414 (8.53)	446.5 (8.29)
	c. Application of fertilizers	7 (1.22)	81.6 (1.46)	88.6 (1.44)	7.5 (1.44)	87 (1.79)	94.5 (1.76)
6.	Weeding	109 (18.91)	609 (10.89)	718 (11.64)	96 (18.37)	573 (11.79	669 (12.43)

Contd…

S. No.	Operations	Balaji variety farms			Local variety farms		
		Pre-bearing (1-3 yrs)	Bearing (4-15 yrs)	Total	Pre-bearing (1-3 yrs)	Bearing (4-15 yrs)	Total
7.	Laying of irrigation channels	90 (15.62)	163 (2.92)	253 (4.09)	82.5 (15.79)	193.12 (3.98)	275.62 (5.13)
8.	Irrigation	60 (10.40)	915 (16.36)	975 (15.79)	45 (8.61)	684 (14.08)	729 (13.55)
9.	Clearing of basins	80 (13.87)	559 (9.99)	639 (10.36)	60 (11.48)	427.40 (8.79)	487.4 (9.05)
10.	Fencing/Fence maintenance	90 (15.61)	360 (6.42)	450 (7.29)	90 (17.22)	360 (7.40)	450 (8.37)
11.	Plant protection chemicals	22.5 (3.90)	326.09 (5.82)	348.59 (5.65)	23 (4.40)	390.50 (8.04)	413.5 (7.69)
12.	Pruning of branches	-	258 (4.62)	258 (4.18)	-	281 (5.79)	281 (5.23)
13.	Harvesting	-	1738 (31.06)	1738 (28.17)	-	1172.5 (24.14)	1172.5 (21.79)
	Total	576.5 (100)	5594.69 (100)	6171.19 (100)	522.55 (100)	4857.83 (100)	5380.38 (100)
	Owned labour	76.88 (13.34)	707.75 (12.65)	784.63 (12.71)	75.64 (14.48)	657.58 (13.54)	733.22 (13.63)
	Hired labour	499.62 (86.66)	4886.94 (87.35)	5386.56 (87.29)	446.91 (85.52)	4200.25 (86.46)	4647.16 (86.37)

Note: Figures in parentheses indicate percentages to the total

Table 4.8. Machine power utilization on acid lime orchard per hectare: Balaji variety (1st – 15th year)

S. No.	Particulars	Years															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.	Land preparation	10 (48.49)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10 (4.35)
2.	Intercultivation	7.5 (36.38)	10 (61.54)	10 (61.54)	10 (51.81)	10 (44.44)	10 (44.44)	-	-	-	-	-	-	-	-	-	57.5 (25.00)
3.	Transportation	3.12 (15.13)	6.25 (38.46)	6.25 (38.46)	9.30 (48.19)	12.5 (55.56)	12.5 (55.56)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	162.42 (70.65)
	Total	20.62 (100)	16.25 (100)	16.25 (100)	19.3 (100)	22.5 (100)	22.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	12.5 (100)	229.92 (100)
	Owned labour	2.27 (11.00)	1.78 (10.90)	1.87 (11.50)	1.70 (8.80)	1.80 (8.00)	1.75 (7.75)	0.82 (6.50)	1.29 (10.25)	1.19 (9.50)	1.10 (8.80)	0.98 (7.90)	1.11 (8.85)	1.25 (10.00)	0.99 (7.85)	1.10 (8.75)	21 (9.14)
	Hired labour	18.35 (89.00)	14.47 (89.10)	14.38 (88.50)	17.60 (91.20)	20.70 (92.00)	20.75 (92.25)	11.68 (93.50)	11.21 (89.75)	11.31 (90.50)	11.40 (91.20)	11.52 (92.10)	11.39 (91.15)	11.25 (90.00)	11.51 (92.15)	11.40 (91.25)	208.92 (90.86)

Note: Figures in parentheses indicate percentages to the total

Table 4.9. Machine power utilization on acid lime orchard per hectare: Local variety (1st – 15th year)

S. No.	Particulars	Years															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.	Land preparation	11.25 (42.86)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.25 (5.15)
2.	Intercultivation	12.5 (47.62)	10 (72.73)	10 (66.67)	10 (57.14)	10 (50.00)	10 (50.00)	-	-	-	-	-	-	-	-	-	62.50 (28.60)
3.	Transportation	2.5 (9.52)	3.75 (27.27)	5 (33.33)	7.5 (42.86)	10 (50.00)	10 (50.00)	10 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	144.75 (66.25)
	Total	26.25 (100)	13.75 (100)	15 (100)	17.5 (100)	20 (100)	20 (100)	10 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	12 (100)	218.5 (100)
	Owned labour	2.70 (10.25)	1.64 (11.90)	1.77 (11.80)	1.39 (7.90)	2.00 (10.00)	1.77 (8.85)	0.85 (8.50)	1.19 (9.90)	1.35 (11.25)	1.19 (9.90)	1.18 (9.80)	1.17 (9.75)	1.02 (8.50)	1.02 (8.50)	1.18 (9.80)	21.42 (9.80)
	Hired labour	23.55 (89.75)	12.11 (88.10)	13.23 (88.20)	16.11 (92.10)	18.00 (90.00)	18.23 (91.15)	9.15 (91.50)	10.81 (90.10)	10.65 (88.75)	10.81 (90.10)	10.82 (90.20)	10.83 (90.25)	10.98 (91.50)	10.98 (91.50)	10.82 (90.20)	197.08 (90.20)

Note: Figures in parentheses indicate percentages to the total

of acid lime orchards, the orchardists of balaji variety used 10 hours per hectare and the growers of local variety employed 11.25 hours per hectare for the land preparation.

4.2.3 Material Input Utilization on Acid Lime Orchards

The material inputs used in the raising of acid lime orchard were plant material, manures, fertilizers and plant protection chemicals. It is observed from Tables 4.10 and 4.11 that a plant population of 225 per hectare was maintained each on the farms of balaji and local varieties which was less than the recommended plant population of 250 trees per hectare. The total quantity of manure applied from 1st to 15th year was 466.5 tonnes per hectare on the orchards of balaji variety and 440.5 tonnes per hectare on the farms of local variety. The orchardists of acid lime applied less than the recommended dosage of FYM per hectare (550 tonnes). Inspite of higher cost, orchardists used greater quantities of manure as a source of nutrients and organic matter which helped to improve the physical condition of predominantly dry lands on which acid lime orchards were cultivated. The use of urea, phosphate and potash for the 15 year period stood at 1880, 6250 and 1250 kg per hectare each on the acid lime orchards of balaji and local varieties.

Plant protection chemicals were applied in the form of dusts (blitox and baviston) and liquids (prophonophos and omite). It can be inferred from the contents of the table that the quantity of plant protection chemical increased with the increase in the age of the orchards. The total quantity of dusts and liquids applied to control the pests and diseases on balaji and local variety farms was 61.86 kg, 94.20 litres and 63.25 kg and 95.50 litres per hectare respectively for the entire period of 15 years

Table 4.10. Material input utilization on acid lime orchard per hectare: Balaji variety (1st- 15th year)

S. No.	Particulars	Years															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.	Plant material (number)	225	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225
2.	Manures (Tonnes)	7.5	15	15	22	30	30	30	30	38	38	38	45	45	45	38	466.5
3.	Fertilizers (kg)																
	19:19:19	-	-	-	125	125	-	-	-	-	-	-	-	-	-	-	387
	Urea	25	50	62			188	188	188	188	188	188	188	188	188	188	1880
	Phosphate	-	-	-			625	625	625	625	625	625	625	625	625	625	6250
	Potash	-	-	-			125	125	125	125	125	125	125	125	125	125	1250
4.	Plant protection chemicals	-	-	-													
	Dusts (kgs)	0.16	0.50	0.50	0.5	1.4	1.4	1.4	4	4	5	5	8	8	11	11	61.86
	Liquid (litres)	0.40	0.42	1.50	1.5	2.5	2.5	2.5	8.6	8.6	10.75	10.75	10.09	10.09	12	12	94.20

Table 4.11. Material input utilization on acid lime orchard per hectare: Local variety (1st- 15th year)

S. No.	Particulars	Years															Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.	Plant material (No.)	225	-	-	-	-	-	-	-	-	-	-	-	-	-		225
1	Manures (Tonnes)	7.5	10	15	22	30	30	30	37	37	37	37	37	37	37	37	440.5
2	Fertilizers (kg)																
	20:20	25	50	62	125	125	-	-	-	-	-	-	-	-	-	-	387
	Urea	-	-	-	-	-	188	188	188	188	188	188	188	188	188	188	1880
	Phosphate	-	-	-			625	625	625	625	625	625	625	625	625	625	6250
	Potash	-	-	-			125	125	125	125	125	125	125	125	125	125	1250
3	Plant protection chemicals																
	Dusts (kg)	0.25	0.50	0.50	0.60	1.5	1.5	1.5	4.2	4.2	5.25	5.25	8	8	11	11	63.25
	Liquid (Litres)	0.50	0.55	1.75	1.7	2.5	2.5	2.5	9	9	10.75	10.75	10	10	12	12	95.50

4.3 COST STRUCTURE OF ACID LIME ORCHARDS

The cost incurred in acid lime cultivation was classified into establishment cost and maintenance cost. Acid lime being a perennial crop comes to bearing from 4th year onwards. All the expenditure made in establishing orchard right from rising the orchard as well as costs incurred to maintain the same till it came to bearing were considered as establishment costs (pre-bearing costs). Maintenance costs included the costs incurred to maintain the orchard from 4th year onwards upto the life of the orchard. The economic life period for balaji and local varieties are 20 and 30 years respectively. The cost of cultivation was divided into variable and fixed costs.

Balaji variety acid lime was introduced in the study area in the year 2002 though the study area was well known for the cultivation of acid lime of local variety since a long time. The data on the technical coefficients of balaji variety were available only for 15 years. Hence, the economic analysis in the present study was confined to 15 years period only for both local and balaji varieties to facilitate comparison between the two varieties of acid lime.

4.3.1 Cost Structure of Acid lime Orchards per Hectare during Pre-bearing Period (1-3 Years)

The expenditure incurred per hectare on inputs and input services in the cultivation of acid lime during the pre-bearing period are presented in Table 4.12.

The total costs incurred during the first year for the establishment of acid lime of balaji variety amounted to ₹ 84,387 per hectare. Out of which operational and fixed cost worked out to ₹ 65,785 (77.95%) and ₹ 18,602 (22.05%) respectively. The total costs during 2nd and 3rd year were ₹ 83,364 and ₹ 92,252 per hectare respectively.

The wage bill of human labour stood out to be the major item of cost component during pre-bearing period of acid lime orchards. The wage bill increased from ₹ 32,300 in the first year to ₹ 45,100 in the 3rd year. The same was ₹ 37,900 in 2nd year. The cost of human labour accounted for 38.27, 45.48 and 48.89 per cent of total cost in 1st, 2nd and 3rd year respectively. The cultural practices such as land preparation, marking of lines, digging of pits, fencing, laying of irrigation channels, clearing of basins, application of manures, fertilizers and plant protection chemicals required more human labour and hence the higher expenditure.

Machine power was the next highest cost component during pre-bearing period on the farms of balaji variety. The expenditure that was incurred under this head was ₹ 16,496 (19.54%), ₹ 13,000 (15.59%) and ₹ 13,000 (14.09%) in 1st, 2nd and 3rd year respectively. Machine power was employed for the operations *viz.*, land preparation, intercultivation and transportation of inputs and output.

Plant material which confined to the 1st year only was the next important cost component. The expenditure towards plant material was ₹ 7,650 per hectare accounting for 9.08 per cent of the total cost.

Expenditure on manures and fertilizers varied from ₹ 4,375 (5.19%) in the 1st year of establishment to ₹ 9,062.50 (9.82%) in the 3rd year. The same was ₹ 8,750 (10.48%) in the 2nd year.

Among the fixed costs, rental value of owned land (₹ 12,500) stood as major item forming 14.81, 14.99 and 13.55 per cent of the total cost during pre-bearing period. Interest on fixed capital which was another item of overhead cost accounted for 5.03, 5.09 and 4.60 per cent of the total cost in the 1st, 2nd and 3rd year respectively.

The per hectare total cost on the acid lime orchards of local variety was estimated at ₹ 88,659, ₹ 74,684 and ₹ 85,543 in the 1st, 2nd and 3rd year respectively. The total cost in the 1st year was higher on account of greater expenditure on machine power and plant material.

Variable costs accounted for 78 per cent in the 1st year compared to 73.89 and 77.19 per cent in the 2nd and 3rd year respectively on local variety acid lime orchards. On the other hand, share of fixed cost was 22 per cent in the 1st year compared to 26.11 and 22.81 per cent of the total costs in 2nd and 3rd year respectively.

Human labour accounted for the major share of the total cost in all the three years of pre-bearing period. The expenditure incurred on this cost component was ₹ 31,810 (35.87%), ₹ 33,600 (44.98%) and ₹ 39,100 (45.70%) per hectare in the 1st year, 2nd year and 3rd year respectively. Further, it was observed that the cost of human labour exhibited direct relationship with the size of the orchards on acid lime farms of balaji and local varieties. This is in confirmity with the results of Vandana *et al* (1996) and Lavanya (1996).

It was evident from Table 4.12 that the use of machine power occupied 2nd position in the total cost. The expenditure incurred towards machinery power was ₹ 21,000 (23.69%), ₹ 11,000 (14.72%), ₹ 12,000 (14.03%) in the 1st, 2nd and 3rd year respectively.

Orchardists of local variety incurred an amount of ₹ 4,275 in the 1st year, ₹ 6,050 in the 2nd year and ₹ 8,812.50 in the 3rd year for the purchase of manures and fertilizers. The expenditure towards plant material was ₹ 6,750 accounting for 7.62 per cent of the total cost.

Among the fixed costs, rental value of owned land stood as a major item forming 14.09 per cent, 16.73 per cent and 14.62 per cent of the total cost in the 1st, 2nd and 3rd year respectively. Farmers of local variety imputed the opportunity cost of their own land at ₹ 12,500 per hectare in each year of

the pre-bearing period. Interest on fixed capital was another item of indirect cost accounting for 3.89, 4.62 and 4.03 per cent in the 1st, 2nd and 3rd year respectively.

The total cost of establishment of acid lime orchards of balaji and local varieties stood at ₹ 2,60,003 and ₹ 2,48,886 per hectare respectively. The cost of human labour, machinery power, manures and fertilizers and rental value of owned land accounted for more than 82 per cent of the total cost on both the varieties of acid lime orchards. It is observed that the cost of human labour was positively related with the age of the orchard on both the categories. On the other hand, the expenditure towards machinery power declined from 1st year to 2nd year on both the categories of farms. The reason for this trend was that the land preparation confined only to the 1st year of establishment of garden making all the difference in the cost component of machinery use during pre-bearing period. Further, it was observed that the total cost during pre-bearing period was slightly higher on the acid lime farms of balaji variety compared to the orchards of local variety.

4.3.2 Cost Structure of Acid lime Orchards per Hectare during Bearing Period (4th – 15th Year)

An examination of particulars furnished in Table 4.13 revealed that the total cost per hectare on the acid lime of orchards of balaji variety increased from ₹ 1,29,442 in the 4th year to ₹ 2,51,880 in the 14th year of bearing period and declined to ₹ 2,32,013 in the 15th year. When total costs were added up from 4th to 15th year, these were ₹ 24,87,200. The share of working costs constituted 72.48 per cent while that of fixed costs 27.52 per cent of total costs on the acid lime orchards of balaji variety.

Human labour continued to be the major item of expenditure with ₹ 11,18,938 accounting for 44.98 per cent of the total costs during bearing period. Harvesting and pruning of branches were the cultural practices

Table 4.12. Cost structure of acid lime orchards per hectare 1st to 3rd year (pre-bearing period)

S. No.	Particulars	Balaji variety farms			Total	Local variety farms			Total
		1	2	3		1	2	3	
1.	**Operational costs**								
	a. Plant material	7650 (9.08)	-	-	7650 (2.95)	6750 (7.62)	-	-	6750 (2.71)
	b. Human labour	32300 (38.27)	37900 (45.48)	45100 (48.89)	115300 (44.34)	31810 (35.87)	33600 (44.98)	39100 (45.70)	104510 (41.99)
	i. Owned	4360.5 (5.17)	4472.2 (5.36)	6539.5 (7.08)	15372.2 (5.91)	4612.45 (5.20)	4334.40 (5.80)	6177.8 (7.22)	15124.65 (6.08)
	ii. Hired	27939.5 (33.10)	33427.8 (40.12)	38560.5 (41.81)	99927.8 (38.43)	27197.55 (30.67)	29265.60 (39.18)	32922.2 (38.48)	89385.35 (35.91)
	c. Machine labour	16496 (19.54)	13000 (15.59)	13000 (14.09)	42496 (16.35)	21000 (23.69)	11000 (14.72)	12000 (14.03)	44000 (17.68)
	i. Owned	1814.56 (2.15)	1417 (1.69)	1495 (1.62)	4726.56 (1.82)	2152.5 (2.43)	1309 (1.75)	1416 (1.66)	4877.5 (1.96)
	ii. Hired	14681.44 (17.39)	11583 (13.90)	11505 (12.47)	37769.44 (14.53)	18847.5 (21.26)	9691 (12.97)	10584 (12.37)	39122.5 (15.72)
	d Manures and fertilizers	4375 (5.19)	8750 (10.48)	9062.5 (9.82)	22187.5 (8.53)	4275 (4.81)	6050 (8.09)	8812.5 (10.30)	19137.5 (7.69)
	i. Manures	3750 (4.44)	7500 (8.99)	7500 (8.13)	18750 (7.21)	3750 (4.22)	5000 (6.69)	7500 (8.77)	16250 (6.53)
	ii. Fertilizers	625 (0.75)	1250 (1.49)	1562.5 (1.69)	3437.5 (1.32)	525 (0.59)	1050 (1.40)	1312.5 (1.53)	2887.5 (1.16)

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S. No.	Particulars	Balaji Variety farms			Total	Local Variety farms			Total
		1	2	3		1	2	3	
	e. Plant protection chemicals	376 (0.44)	594 (0.72)	1350 (1.47)	2320 (0.89)	500 (0.57)	685 (0.94)	1525 (1.78)	2710 (1.09)
	f. Interest on working capital	4588 (5.43)	4518 (5.43)	5137 (5.56)	14243 (5.48)	4824 (5.44)	3849 (5.16)	4606 (5.38)	13279 (5.33)
	Total operational costs	65785 (77.95)	64762 (77.70)	73650 (79.83)	204197 (78.54)	69159 (78.00)	55184 (73.89)	66043 (77.19)	190386 (76.49)
2.	**Fixed costs**								
	a. Depreciation	1827 (2.18)	1827 (2.19)	1827 (1.99)	5481 (2.11)	3535 (3.99)	3535 (4.73)	3535 (4.13)	10605 (4.26)
	b. Land revenue	25 (0.03)	25 (0.03)	25 (0.03)	75 (0.03)	25 (0.03)	25 (0.03)	25 (0.03)	75 (0.03)
	c. Rental value of owned land	12500 (14.81)	12500 (14.99)	12500 (13.55)	37500 (14.42)	12500 (14.09)	12500 (16.73)	12500 (14.62)	37500 (15.07)
	d. Interest on fixed capital	4250 (5.03)	4250 (5.09)	4250 (4.60)	12750 (4.90)	3440 (3.89)	3440 (4.62)	3440 (4.03)	10320 (4.15)
	Total fixed costs	18602 (22.05)	18602 (22.30)	18602 (20.17)	55806 (21.46)	18602 (22.00)	18602 (26.11)	18602 (22.81)	58500 (23.51)
	Total costs	84387 (100)	83364 (100)	92252 (100)	260003 (100)	88659 (100)	74684 (100)	85543 (100)	248886 (100)

Note: Figures in parentheses indicate percentages to the total

performed during the bearing period in addition to the operations of pre-bearing period. Hence the higher expenditure on human labour. Unlike in pre-bearing period where machinery power occupied second position, manures and fertilizers ranked second among the operational costs during bearing period. The expenditure to this material input was ₹ 2,91,030 (11.69%) for the entire 12 year bearing period. The expenditure on manures and fertilizers increased from ₹ 14,125 in 4th year to ₹ 29,178 in 12th year, the year from which the orchard started giving economic yields. The expenditure remained the same from 12th year to 15th year. The orchardists felt that it was necessary to apply higher quantities of manures and fertilizers to reap good harvest during the bearing period.

Machinery power and plant protection were the other items on which farmers spent ₹ 1,66,240 (6.68%) and ₹ 1,00,736 (4.06%) per hectare for the entire 12 years of bearing period.

The rental value of owned land not only a major item of fixed cost but also a cost component which occupies second place in the total costs. It was ₹ 43,000 per hectare. The rental value of owned land remains the same in each year of the bearing period. In the study area a tenant pays a rent of ₹ 17,000 per acre regardless of the yields and hence the uniformity in the rental value of land from 4th year to 15th year of bearing period. The other items of fixed costs were apportioned cost of establishment and interest on fixed capital accounting for 6.28 per cent and 2.06 per cent respectively on the acid lime orchards of balaji variety.

An examination of particulars furnished in Table 4.14, it is evident that total costs incurred on the farms of local variety increased from ₹ 1,20,326.62 in 4th year to ₹ 2,13,968 per hectare in the 14th year. The total costs declined in the 15th year of acid lime orchard. The operational costs increased from ₹ 92,530.62 in the 4th year to ₹ 1,58,672 in the 14th year.

Similarly, the fixed costs on the orchards of local variety increased from ₹ 27,796 to ₹ 55,296 during the bearing period. The share of operational and fixed costs for the entire 12 years of bearing period was 72.33 per cent and 27.67 per cent respectively.

Like in balaji variety farms, the major cost item during bearing period of local variety farms was human labour. Costs incurred on this input service increased from ₹ 56,900 in the 4th year to ₹ 97,824 in the 14th year and declined to ₹ 82,824 in the 15th year. The cost of human labour employment accounted for 44.16 per cent of the total cost for the entire bearing period. The increase in the expenditure on human labour utilization is due to increase in the demand for labour for operations like harvesting, irrigation, weeding, application of manures and fertilizers *etc*. during bearing period.

Cost of manures and fertilizers was the next major component among the variable costs from 4th year to 15th year. The expenditure incurred towards this material input for the entire bearing period was ₹ 2,76,030 accounting for 12.54 per cent of the total cost. Machine power was the third important item in the cost structure of acid lime orchard of local variety. The total cost incurred towards this item was ₹ 1,30,800 (5.94%). Orchardists of local variety spent ₹ 1,02,090 on plant protection chemicals during the entire bearing period. Interest on working capital accounted for 5.05 per cent of the total costs.

Rental value of owned land was the major item among the fixed costs accounting for 19.33 per cent of the total costs. The rental value of owned land estimated at ₹ 40,000 per hectare. In fact rental value of owned land was the second largest item of expenditure in the cost structure of acid lime orchards on both the varieties of farms. Apportioned cost of establishment and interest on fixed capital were the other items of fixed costs accounting for 4.52 and 1.88 per cent of total costs during bearing period.

An overview of the cost structure of acid lime orchards of balaji and local varieties revealed that the total costs for the entire bearing period were more on the farms of balaji variety (₹ 24,87,200.40) compared to the farms of local variety (₹ 22,00,066.62). The yields were higher in the case of balaji variety and this necessitated the employment of more human resource. Also, the orchardists of balaji variety applied more organic manure in order to reap higher output. These are the reasons for higher costs on the farms of balaji variety compared to the farms of local variety. The expenditure on inputs and input services (operational costs) showed an increasing trend throughout the bearing period on both the categories of farms and thus indicating positive relationship between maintenance cost and age of the orchards. This is because of the use of more quantity of inputs and input services such as manures, fertilizers, plant protection chemicals and human labour with the increase in the age of the orchards. These results are in agreement with the findings of Azad *et al* (1988), Vandana *et al* (1996) and Lavanya (1996). On the contrary, fixed costs more or less remained the same from 6^{th} to 15^{th} year of the bearing period. The rental value of owned land was less in 4^{th} and 5^{th} year because of low yields. The orchard begins to give economical yields from 6^{th} year onwards and hence the increase in the rental value of owned land.

4.3.4 Cost Structure per Hectare of Acid lime Orchards for 15 Years

With respect to perennial crop like acid lime having a long gestation period and continuous yields for a number of years, calculations of costs should include both the cost of establishing orchard as well as its annual maintenance. The cost incurred during pre-bearing period (1^{st}-3^{rd} year) was regarded as the establishment cost. These included the labour costs incurred on operations such as land preparation, marking of lines, digging of pits, laying of irrigation channels, clearing of basins, planting, manuring, intercultivation, fencing and maintenance, weeding, irrigation, plant

Table 4.13. Cost structure of acid lime orchard per hectare - Balaji variety: 4th - 15th year (Bearing period)

S. No.	Particulars	Years												Total
		4	5	6	7	8	9	10	11	12	13	14	15	
1.	**Operational costs**													
	a. Human labour	60100 (46.43)	79694 (50.15)	79074 (41.06)	76070 (42.09)	91200 (44.87)	96400 (44.63)	96400 (44.20)	101400 (45.38)	102400 (44.06)	117400 (47.24)	117400 (46.60)	101400 (43.70)	1118938 (44.98)
	i. Owned	9315.5 (7.19)	10957.93 (6.89)	9884.25 (5.13)	8291.63 (4.59)	10852.8 (5.34)	10122 (4.68)	12050 (5.52)	16680.30 (7.46)	14745.60 (6.35)	13853.20 (5.57)	12600.50 (5.00)	12168 (5.24)	141521.71 (5.69)
	ii. Hired	50784.5 (39.24)	68736.07 (43.26)	69189.75 (35.93)	67778.37 (37.50)	80347.2 (39.53)	86278 (39.95)	84350 (38.68)	84719.70 (37.92)	87654.40 (37.71)	103546.80 (41.67)	104799.50 (41.60)	89232 (38.46)	977416.29 (39.29)
	b. Machine power	15440 (11.92)	18000 (11.32)	18000 (9.34)	10000 (5.54)	10000 (4.93)	12480 (5.78)	12480 (5.74)	12480 (5.58)	14960 (6.43)	14960 (6.01)	14960 (5.95)	12480 (5.39)	166240 (6.68)
	i. Owned	1358.72 (1.04)	1440 (0.90)	1395 (0.72)	650 (0.35)	1025 (0.50)	1185.60 (0.54)	1098.24 (0.50)	985.92 (0.44)	1323.96 (0.56)	1496 (0.60)	1174.36 (0.47)	1092 (0.47)	14224.80 (0.57)
	ii. Hired	14081.28 (10.88)	16560 (10.42)	16605 (8.62)	9350 (5.19)	8975 (4.43)	11294.40 (5.24)	11381.76 (5.24)	11494.08 (5.14)	13636.04 (5.87)	13464 (5.41)	13785.64 (5.48)	11388 (4.92)	152015.20 (6.11)
	c. Manures and fertilizers	14125 (10.91)	18125 (11.4)	21678 (11.27)	21678 (11.99)	21678 (10.66)	25678 (11.88)	25678 (11.79)	25678 (11.48)	29178 (12.57)	29178 (11.74)	29178 (11.60)	29178 (12.57)	291030 (11.69)
	i. Manures	11000 (8.49)	15000 (9.44)	15000 (7.79)	15000 (8.30)	15000 (7.38)	19000 (8.79)	19000 (8.71)	19000 (8.50)	22500 (9.69)	22500 (9.06)	22500 (8.94)	22500 (9.69)	218000 (8.76)
	ii. Fertilizers	3125 (2.42)	3125 (1.96)	6678 (3.48)	6678 (3.69)	6678 (3.28)	6678 (3.09)	6678 (3.08)	6678 (2.98)	6678 (2.88)	6678 (2.68)	6678 (2.66)	6678 (2.88)	73030 (2.93)
	d. Plant protection chemicals	1350 (1.04)	2590 (1.64)	2590 (1.35)	2590 (1.44)	8420 (4.15)	8420 (3.89)	10525 (4.83)	10525 (4.71)	11863 (5.10)	11863 (4.78)	15000 (5.95)	15000 (6.48)	100736 (4.06)
	e. Interest on working capital	6825 (5.28)	8880 (5.59)	9100 (4.73)	8274 (4.57)	9846 (4.85)	10992 (5.08)	10881 (4.98)	11256 (5.04)	11880 (5.12)	13005 (5.25)	13240 (5.26)	11853 (5.10)	126032 (5.07)
	Total operational costs	97840 (75.58)	127289 (80.10)	130442 (67.75)	118612 (65.63)	141144 (69.46)	153970 (71.26)	155964 (71.54)	161339 (72.19)	170281 (73.28)	186406 (75.02)	189778 (75.36)	169911 (73.24)	1802976 (72.48)

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S. No.	Particulars	Years												Total
		4	5	6	7	8	9	10	11	12	13	14	15	
2.	**Fixed costs**													
	a. Depreciation	1827 (1.42)	1827 (1.14)	1827 (0.94)	1827 (1.02)	1827 (0.89)	1827 (0.84)	1827 (0.83)	1827 (0.81)	1827 (0.79)	1827 (0.73)	1827 (0.72)	1827 (0.79)	21924 (0.88)
	b. Land revenue	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	300 (0.01)
	c. Rental value of owned land	43000 (9.66)	43000 (7.88)	43000 (22.34)	43000 (23.79)	43000 (21.16)	43000 (19.90)	43000 (19.71)	43000 (19.26)	43000 (18.50)	43000 (17.30)	43000 (17.08)	43000 (18.53)	455000 (18.29)
	d. Interest on fixed capital	4250 (3.29)	4250 (2.68)	4250 (2.20)	4250 (2.36)	4250 (2.09)	4250 (1.98)	4250 (1.95)	4250 (1.90)	4250 (1.83)	4250 (1.71)	4250 (1.68)	4250 (1.83)	51000 (2.06)
	e. Apportioned cost of establishment	13000 (10.04)	13000 (8.19)	13000 (6.76)	13000 (7.19)	13000 (6.39)	13000 (6.01)	13000 (5.96)	13000 (5.83)	13000 (5.59)	13000 (5.23)	13000 (5.16)	13000 (5.60)	156000 (6.28)
	Total fixed costs	31602 (24.42)	31602 (19.90)	62102 (32.25)	62102 (34.37)	62102 (30.54)	62102 (28.74)	62102 (28.46)	62102 (27.81)	62102 (26.72)	62102 (24.98)	62102 (24.64)	62102 (26.76)	684224 (27.52)
	Total costs	129442 (100)	158891 (100)	192544 (100)	180714 (100)	203246 (100)	216072 (100)	218066 (100)	223441 (100)	232383 (100)	248508 (100)	251880 (100)	232013.4 (100)	2487200.4 (100)

Note: Figures in parentheses indicate percentages to the total

Table 4.14. Cost structure of acid lime orchard per hectare – Local variety: 4th-15th year (Bearing period)

S. No.	Particulars	Years												Total
		4	5	6	7	8	9	10	11	12	13	14	15	
1.	**Operational costs**													
	a. Human labour	56900 (47.29)	64150 (47.25)	66050 (38.93)	76374 (44.36)	73324 (40.51)	87824 (44.68)	87824 (44.23)	87824 (44.22)	92824 (45.25)	97824 (46.47)	97824 (45.72)	82824 (41.86)	971566 (44.16)
	i. Owned	9331.6 (7.76)	9526.27 (7.01)	9167.74 (5.40)	9035.05 (5.24)	8674.23 (4.79)	10758.44 (5.47)	15228.69 (7.66)	13252.65 (6.67)	12763.3 (6.22)	11592.15 (5.50)	11611.71 (5.42)	10560.06 (5.33)	131501.89 (5.98)
	ii. Hired	47568.40 (39.53)	54623.72 (40.24)	56882.26 (33.53)	67338.95 (39.12)	64649.77 (35.72)	77065.56 (39.21)	72595.31 (36.57)	74571.35 (37.55)	80060.7 (39.03)	86231.85 (40.97)	86212.29 (40.30)	72263.94 (36.53)	840064.11 (38.18)
	b. Machine power	14000 (11.63)	16000 (11.79)	16000 (9.43)	8000 (4.65)	9600 (5.30)	9600 (4.88)	9600 (4.83)	9600 (4.83)	9600 (4.68)	9600 (4.56)	9600 (4.49)	9600 (4.85)	130800 (5.94)
	i. Owned	1106 (0.91)	1600 (1.17)	1416 (0.83)	680 (0.39)	950.4 (0.53)	1080 (0.54)	950.4 (0.47)	940.8 (0.47)	936 (0.45)	816 (0.38)	816 (0.38)	940.8 (0.47)	12232.4 (0.55)
	ii. Hired	12894 (10.72)	14400 (10.62)	14584 (8.6)	7320 (4.26)	8649.6 (4.77)	8520 (4.34)	8649.6 (4.36)	8659.2 (4.36)	8664 (4.23)	8784 (4.18)	8784 (4.11)	8659.2 (4.38)	118567.6 (5.39)
	c. Manures and fertilizers	13625 (11.32)	17625 (12.98)	21678 (12.79)	21678 (12.59)	25178 (13.93)	25178 (12.81)	25178 (12.69)	25178 (12.70)	25178 (12.27)	25178 (11.97)	25178 (11.77)	25178 (12.72)	276030 (12.54)
	i. Manures	11000 (9.14)	15000 (11.05)	15000 (8.84)	15000 (8.71)	18500 (10.24)	18500 (9.41)	18500 (9.32)	18500 (9.32)	18500 (9.02)	18500 (8.79)	18500 (8.65)	18500 (9.35)	204000 (9.27)
	ii. Fertilizers	2625 (2.18)	2625 (1.93)	6678 (3.95)	6678 (3.88)	6678 (3.69)	6678 (3.40)	6678 (3.37)	6678 (3.38)	6678 (3.25)	6678 (3.18)	6678 (3.12)	6678 (3.37)	72030 (3.27)
	d. Plant protection chemicals	1550 (1.29)	2650 (1.96)	2650 (1.56)	2650 (1.56)	8820 (4.87)	8820 (4.49)	10675 (5.38)	10675 (5.38)	11800 (5.75)	11800 (5.60)	15000 (7.01)	15000 (7.58)	102090 (4.64)
	e. Interest on working capital	6455.62 (5.36)	7531 (5.55)	7977 (4.70)	8152 (4.73)	8769 (4.84)	9856 (5.01)	9994 (5.03)	9994 (5.03)	10455 (5.10)	10830 (5.14)	11070 (5.17)	9945 (5.03)	111028.62 (5.05)
	Total operational costs	92530.62 (76.89)	107956 (79.53)	114355.45 (67.41)	116854.55 (67.89)	125691 (69.45)	141278 (71.87)	143271 (72.16)	143271 (72.16)	149857 (73.05)	155232 (73.74)	158672 (74.16)	142547 (72.04)	1591515.62 (72.33)

Contd…

S. No.	Particulars	Years												Total
		4	5	6	7	8	9	10	11	12	13	14	15	
2.	**Fixed costs**													
	a. Depreciation	3535 (2.95)	3535 (2.60)	3535 (2.08)	3535 (2.05)	3535 (1.96)	3535 (1.80)	3535 (1.78)	3535 (1.78)	3535 (1.72)	3535 (1.68)	3535 (1.65)	3535 (1.79)	42420 (1.93)
	b. Land revenue	25 (0.02)	25 (0.02)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	25 (0.01)	300 (0.01)
	c. Rental value of owned land	12500 (10.39)	12500 (9.21)	40000 (23.58)	40000 (23.23)	40000 (22.10)	40000 (20.35)	40000 (20.14)	40000 (20.14)	40000 (19.50)	40000 (19.00)	40000 (18.69)	40000 (20.23)	425000 (19.33)
	d. Interest on fixed capital	3440 (2.86)	3440 (2.53)	3440 (2.03)	3440 (2.00)	3440 (1.90)	3440 (1.75)	3440 (1.74)	3440 (1.73)	3440 (1.68)	3440 (1.63)	3440 (1.61)	3440 (1.74)	41280 (1.88)
	e. Apportioned cost of establishment	8296 (6.89)	8296 (6.11)	8296 (4.89)	8296 (4.82)	8296 (4.58)	8296 (4.22)	8296 (4.17)	8296 (4.18)	8296 (4.04)	8296 (3.94)	8296 (3.88)	8296 (4.19)	99552 (4.52)
	Total fixed costs	27796 (23.11)	27796 (20.47)	55296 (32.59)	55296 (32.11)	55296 (30.55)	55296 (28.13)	55296 (27.84)	55296 (27.84)	55296 (26.95)	55296 (26.26)	55296 (25.84)	55296 (27.96)	608552 (27.67)
	Total costs	120326.62 (100)	135752 (100)	169651 (100)	172150 (100)	180987 (100)	196574 (100)	198567 (100)	198567 (100)	205153 (100)	210528 (100)	213968 (100)	197843 (100)	2200066.62 (100)

Note: Figures in parentheses indicate percentages to the total

protection *etc*. The material costs comprises of planting material, manures, fertilizers, plant protection chemicals *etc*. and cost machinery services. All the costs incurred annually for the maintenance and production on the acid lime orchards from the 4th year till the economic life span of the orchards were considered as maintenance costs. It included human labour cost on cultural operations like weeding, irrigation, manuring, maintenance of irrigation channels, plant protection, harvesting, cost of machinery services and cost of material inputs like fertilizers, manures, plant protection chemicals *etc*. The fixed costs like depreciation, land revenue, rent on owned land, interest on fixed capital and apportioned cost of establishment were also included. The particulars of cost of cultivation of acid lime orchards for the entire 15 years period are presented in Table 4.15 and in Fig. 4.1.

The total cost for the 15 years of acid lime orchards worked out to ₹ 24,87,200.40 on balaji variety orchards as against ₹ 22,00,066.62 on local variety farms. The breakup of total cost into operational and fixed costs indicated that the operational costs were ₹ 18,02,976 and ₹ 15,91,515.62 and fixed costs ₹ 6,84,224 and ₹ 6,08,552 and accounted for 72.48 and 72.33 and 27.52 and 27.67 per cent of the total costs on balaji and local variety acid lime orchards respectively. Of the total costs, human labour was the highest item of cost with ₹ 11,18,938 and ₹ 9,71,566 on the farms of balaji and local varieties respectively. This item of expenditure accounted for 44.98 per cent 44.16 per cent of the total cost on the above said categories of farms respectively.

The second important item of cost was rental value of owned land amounting to ₹ 4,55,000 and ₹ 4,25,000 accounting for 18.29 and 19.33 per cent of the total costs on balaji and local variety orchards. The cost of manures and fertilizers was the next major cost on both balaji and local variety farms which amounted to ₹ 2,91,030 and ₹ 2,76,030 farming 11.69 and 12.54 per cent of the total costs respectively.

Next important item of cost was machinery power which accounted for 6.68 and 5.94 per cent of the total costs on the farms of balaji and local varieties respectively. The cost of plant protection chemicals was ₹ 1,00,736 (4.06%) and ₹ 1,02,090 (4.64%) on the above said farms in the same order.

Apportioned cost of establishment and interest on fixed capital were the items of fixed costs with ₹ 1,56,000, ₹ 99,552 and ₹ 51,000 and ₹ 41,280 on balaji and local variety acid lime orchards.

The analysis of cost structure of acid lime orchards led to the conclusion that the total cost were higher by ₹ 2,87,133.78 on the acid lime orchards of balaji variety over local variety. This is due to relatively higher expenditure on human labour, machinery power, manure *etc*.

4.4 RETURNS FROM ACID LIME ORCHARDS

No intercrops were taken by the orchardists in the study area during the pre-bearing period. Acid lime orchards commence bearing from 4th year onwards. Good yields are obtained from 7th year onwards. The details on yield, gross and net returns are provided in Table 4.16 and in Fig. 4.2.

On the acid lime orchards of balaji and local varieties, during 4th year a hectare of orchard yielded 40 and 9.6 quintals respectively. As the age of the orchard increased the yield also increased to 240 quintals on balaji variety farms and 200 quintals on local variety farms during 14th year. The gross income realized in the cultivation of acid lime of balaji and local varieties was estimated at ₹ 40,30,000 and ₹ 32,30,000 per hectare respectively for the entire bearing period. Though the gross income is a measure to assess the efficiency of farm business, but it alone does not help us to judge the success of the farm business. Therefore, another measure namely net income which represents the surplus over the total cost was estimated. Higher net income reflects the degree of success of farm business. Orchardists of balaji

Table 4.15. Cost structure of acid lime orchards per hectare for 15 years

S. No.	Particulars	Balaji variety farms	Local variety farms
1.	**Operational costs**		
	a. Human labour	1118938 (44.98)	971566 (44.16)
	i. Owned	141521.71 (5.69)	131501.89 (5.98)
	ii. Hired	977416.29 (39.29)	840064.11 (38.18)
	b. Machine labour	166240 (6.68)	130800 (5.94)
	i. Owned	14224.80 (0.57)	12232.4 (0.55)
	ii. Hired	152015.20 (6.11)	118567.6 (5.39)
	c. Manures and fertilizers	291030 (11.69)	276030 (12.54)
	i. Manures	218000 (8.76)	204000 (9.27)
	ii. Fertilizers	73030 (2.93)	72030 (3.27)
	d. Plant protection chemicals	100736 (4.06)	102090 (4.64)
	e. Interest on working capital	126032 (5.07)	111028.62 (5.05)
	Total operational costs	1802976 (72.48)	1591515.62 (72.33)
2.	**Fixed costs**		
	a. Depreciation	21924 (0.88)	42420 (1.93)
	b. Land revenue	300 (0.01)	300 (0.01)
	c. Rental value of owned land	455000 (18.29)	425000 (19.33)
	d. Interest on fixed capital	51000 (2.06)	41280 (1.88)
	e. Apportioned cost of establishment	156000 (6.28)	99552 (4.52)
	Total fixed costs	684224 (27.52)	608552 (27.67)
	Total costs	2487200.40 (100)	2200066.62 (100)

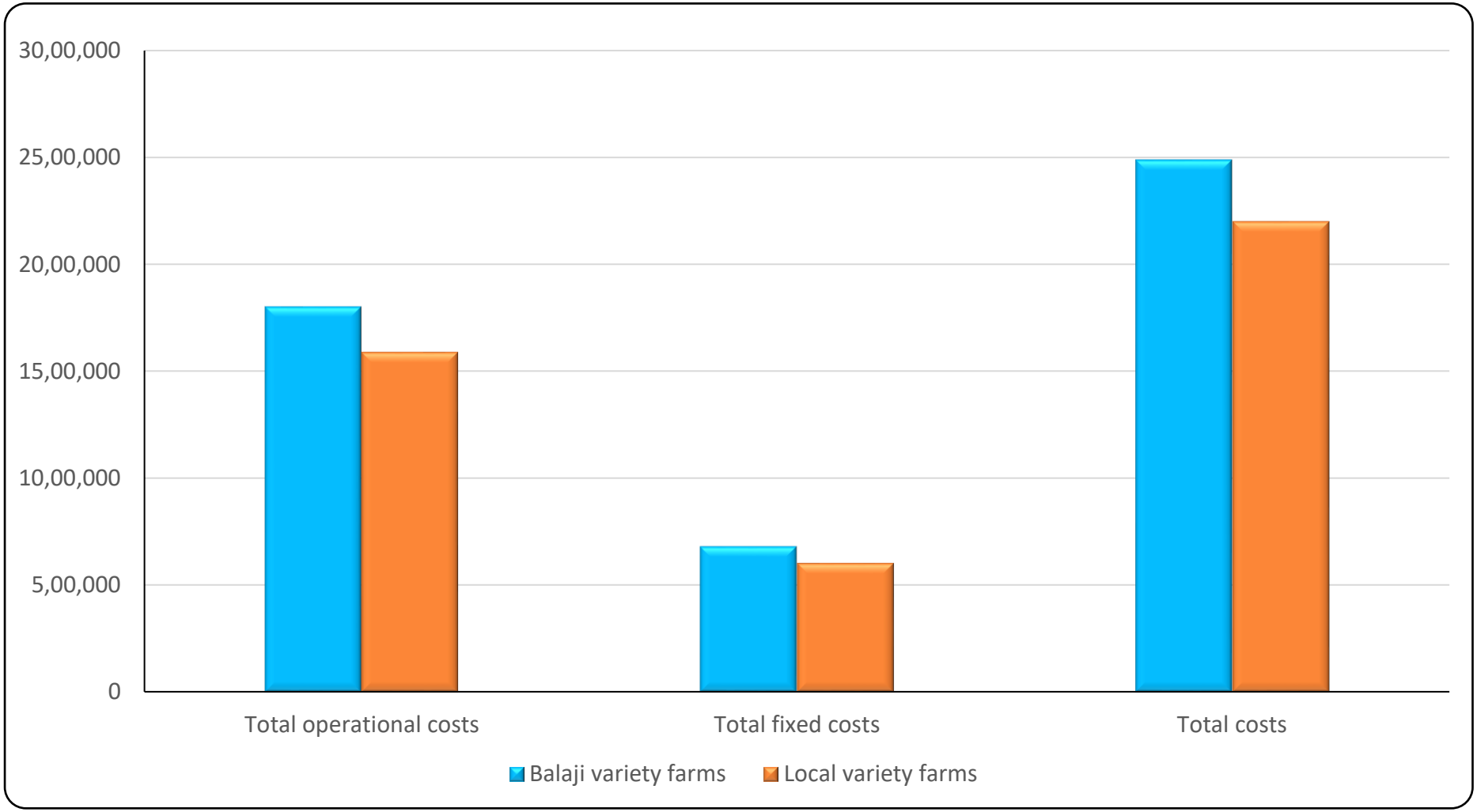

Fig. 4.1. Cost structure of acid lime orchards per hectare for 15 years

variety and local variety realized a net income of ₹ 12,82,797 and ₹ 7,81,047.40 per hectare respectively.

From the above analysis, it is clear that the acid lime yields in the case of balaji and local variety farms increased from 4th year to 14th year and then declined in the 15th year. The orchardists of balaji variety earned higher net income (₹ 12,82,797.00) compared to the orchardists of local variety (₹ 7,81,047.40). This is because of higher yields obtained by the growers of balaji variety during bearing period. The acid lime cultivation is quite profitable at existing prices and holds bright promise for the future.

4.4.1 Costs and Returns per Quintal of Acid lime Production

The contents of Table 4.17 reveal that the orchardists incurred ₹ 1,542.93 and ₹ 1,702.83 to produce a quintal of acid lime of balaji and local varieties respectively. The orchardists of balaji and local varieties realized a net income of ₹ 957.07 and ₹ 797.17 per quintal respectively. This indicates the profitability of acid lime cultivation of both the varieties. From the analysis on costs and returns per quintal of acid lime, it is found that the cost of production was higher on local variety farms compared to the farms of balaji variety. However, the net income obtained by the orchardists growing balaji variety was higher than that of the net income realized by the growers of local variety.

4.5 ECONOMIC VIABILITY (CAPITAL PRODUCTIVITY) OF ACID LIME ORCHARDS

The costs and returns are not the perfect measures to assess the profitability of the investment made on acid lime orchards. The costs and returns from acid lime orchards are not comparable like in the field crops. In case of annual crops, the returns from investment can be obtained within a year which is not possible in the case of acid lime being a perennial crop. This shows the need to estimate deferred returns by discounting future returns.

Table 4.16. Returns on acid lime orchards per hectare for 15 years

Years	Balaji variety farms				Local variety farms			
	Yield (Quintals)	Gross returns (₹)	Total costs (₹)	Net returns (₹)	Yield (Quintals)	Gross returns (₹)	Total costs (₹)	Net returns (₹)
1	-	-	84387	-84387	-	-	88659	-88659
2	-	-	83364	-83364	-	-	74684	-74684
3	-	-	92252	-92252	-	-	85543	-85543
4	40	100000	129442	-29442	9.6	24000	120326.62	-96326.62
5	50.4	126000	158891	-32891	30.4	76000	135752	-59752
6	69.6	174000	192544	-18544	48	120000	169651	-49651
7	92	230000	180714	49286	68	170000	172150	-2150
8	112	280000	203246	76754	88	220000	180987	39013
9	128	320000	216072	103928	108	270000	196574	73426
10	144	360000	218066	141934	120	300000	198567	101433
11	160	400000	223441	176559	140	350000	198567	151433
12	160	400000	232383	167617	140	350000	205153	144847
13	240	600000	248508	351492	180	450000	210528	239472
14	240	600000	251880	348120	200	500000	213968	286032
15	176	440000	232013.40	207986.6	160	400000	197843	202157
Total	1612	4030000	2747203.40	1282797	1292	3230000	2448952.62	781047.40

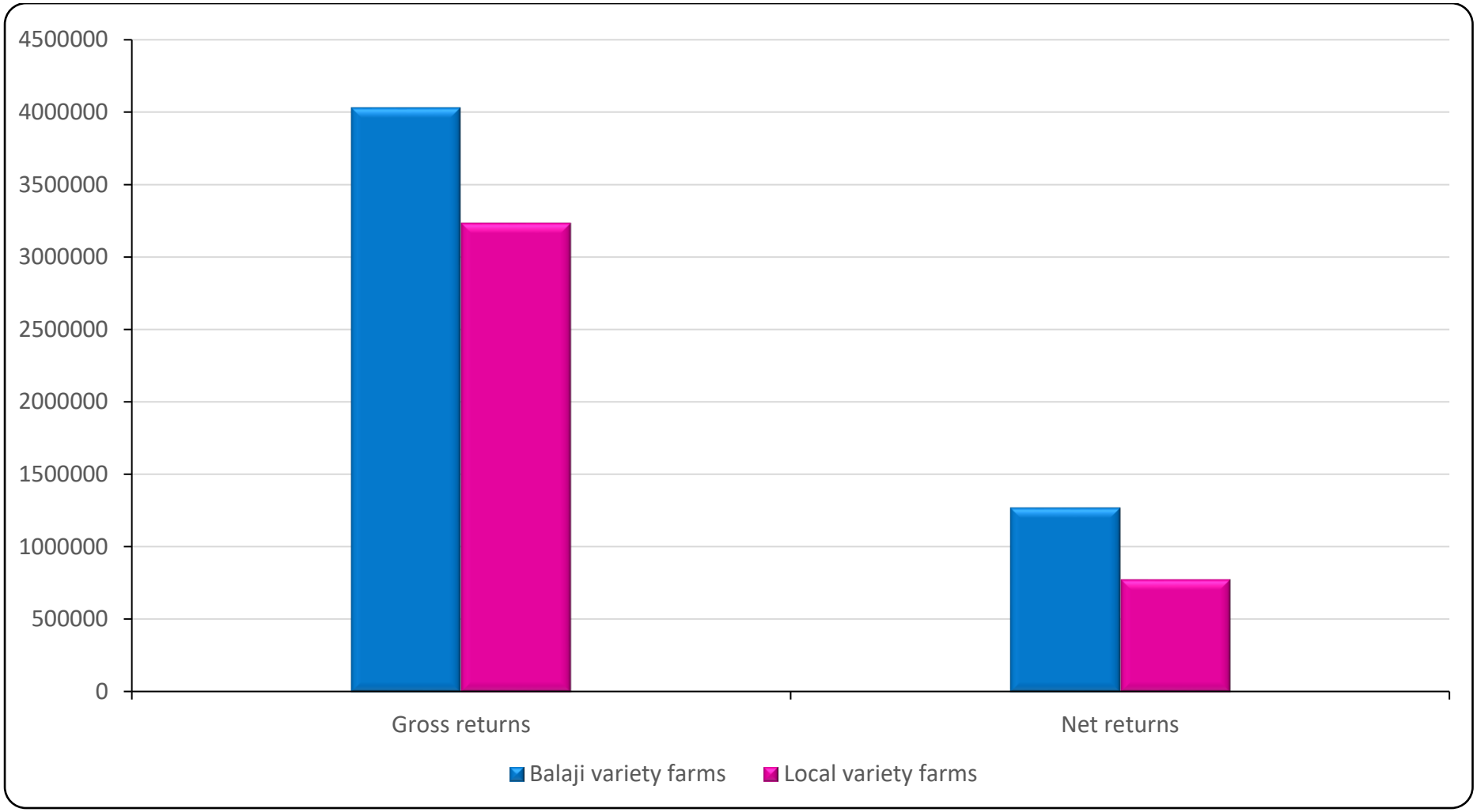

Fig. 4.2. Returns on acid lime orchards per hectare for 15 years

Table 4.17. Costs and returns per quintal of acid lime

(in Rupees)

S. No	Particulars	Balaji variety farms	Local variety farms
1.	Average Variable Cost (AVC)	1118.47	1213.82
2.	Average Fixed Cost (AFC)	424.46	471.01
3.	Average Total Cost (ATC)	1542.93	1702.83
4.	Gross income	2500.00	2500.00
5.	Net income	957.07	797.17

In the present study, the costs and returns had been discounted at 12, 16, 18, 20 and 24 per cent to estimate the present worth of future returns. The net present worth (NPW), benefit-cost ratio (B-C ratio) and internal rate of return (IRR) for balaji and local variety farms were worked out and presented in Tables 4.18 and 4.19.

4.5.1 Net Present Worth (NPW)

Net present worth (NPW) is the first measure of economic evaluation of any investment proposal. It is the difference between discounted costs and benefits. NPW indicates the surplus money that could be generated by the investment proposal. As is evident from Tables 4.18 and 4.19, the net present worth is positive indicating financial feasibility of investment on acid lime.

The net present worth was as high as ₹ 4,89,216.87 and ₹ 2,91,692.20 at 12 per cent discount rate on balaji and local varieties of farms respectively. The same was ₹ 95,149.59 and ₹ 5,878.26 at 24 per cent discount rate on the above said farms in the same order. The high positive net present value even at higher discount rates indicated the soundness of the investment made on acid lime orchards of both the varieties.

4.5.2 Benefit-Cost Ratio (B-C ratio)

It is the second measure of investment appraisal. This indicates returns per rupee of investment. The benefit-cost ratio worked out to be 1.67 at 12 per cent discount rate and 1.25 at 24 per cent on the farms of balaji variety. The same in the case of local variety farms was 1.44 and 1.01 for the corresponding discount rates indicating that a rupee invested would fetch a gross income of ₹ 1.67 and ₹ 1.44 at 12 per cent discount rate for aforesaid farms respectively. In other words, each rupee of investment made in acid lime cultivation would bring a net income of ₹ 0.67 on the farms of balaji variety and ₹ 0.44 on the farms of local variety. These values proved that the

investment on acid lime production was economically feasible on both the varieties of acid lime orchards. These findings are in conformity with the results of Subramanyam (1996), Lavanya (1996) and Vandana *et al* (1996).

4.5.3 Internal Rate of Return (IRR)

It is an indicator of average earning power of investment proposal. It is another tool of discounted cash flow measure to appraise profitability of investment. It is indeed to estimate the discount rate which makes net present value zero. The internal rate of return was found to be 33.17 per cent and 24.60 per cent for balaji and local variety acid lime orchards respectively. The internal rate of return was more than the bank rate of interest (15%) and hence acid lime cultivation is economically feasible. An investor cannot borrow capital at higher than IRR for making investment in acid lime cultivation. In other words, this is the maximum rate at which prospective acid lime orchardists can borrow and invest.

It is evident from the above results that the net present worth was positive and benefit-cost ratio was more than unity at all the discount rates indicating financial soundness of the investment in acid lime orchards. Further, the results also revealed that the net present worth and benefit-cost ratio at different rates of discount were higher on the orchards of balaji variety over local variety orchards reflecting higher productivity of capital on the farms of balaji variety.

4.5 PROBLEMS ON PRODUCTION AND MARKETING OF ACID LIME

A survey was conducted to know the problems faced by farmers in the production and marketing of acid lime in general and balaji variety in particular. The information on problems was obtained from the selected farmers and their responses are presented in Table 4.20.

Table 4.18. Estimates of economic viability of acid lime orchard – Balaji variety

Particulars	Discount Rate (%)				
	12	**16**	**18**	**20**	**24**
NPW (₹)	489216.87	297464.04	229466.14	174842.97	95149.59
B:C ratio	1.67	1.52	1.45	1.38	1.25
IRR (%)	33.17				

Table 4.19. Estimates of economic viability of acid lime orchard – Local variety

Particulars	Discount Rate (%)				
	12	**16**	**18**	**20**	**24**
NPW (₹)	291692.20	149119.18	99794.36	60894.90	5878.26
B:C ratio	1.44	1.29	1.22	1.15	1.01
IRR (%)	24.60				

High degree of perishability, low prices and price volatility and lack of regulated market were identified as major problems by all the farmers. Farmers were of the opinion that balaji variety of acid lime is highly perishable and could not be stored atleast for a week. Acid lime growers of balaji variety resorted to distress sale due to high degree of perishability. Lack of technical knowledge in growing acid lime was reported as a serious problem by 75 per cent of farmers. Inadequacy of institutional credit was reported by 70 per cent of the growers. Paucity of labour during peak seasons of weeding, harvesting *etc*. was the problem for about 65 per cent of the total respondents. About 62 per cent of acid lime growers felt that the incidence of pests and diseases was an important problem. Inability in expanding the acerage under acid lime due to limited irrigation water was considered as a problem by 60 per cent of the respondents. The farmers were willing to expand their acerage under acid lime as they felt it was profitable enterprise in the region but due to declining water table level they were not in a position to expand the area under acid lime.

Table 4.20. Problems on production and marketing of acid lime

S. No	Particulars	Total score in per cent
1.	Lack of technical knowledge	75
2.	Inadequate credit	70
3.	Shortage of labour during peak hours	65
4.	Incidence of pests and diseases	62.5
5.	Problem of expanding the acreage under acid lime due to limited irrigation water available	60
6.	High degree of perishability	100
7.	Low prices and price fluctuations	100
8.	Absence of regulated market	100

Chapter ~ V

Summary & Conclusions

Chapter – V

SUMMARY AND CONCLUSIONS

Horticulture potential in India is much more than what has been realized so far. Apart from helping the country in achieving nutritional security by bridging the nutritional gap, horticultural crops also help in maintaining ecological balance through increased biomass production per unit area. On account of their labour intensiveness these crops generate employment opportunities for rural masses and are more remunerative than other crops. Horticulture activity leads to development of industrial base in rural areas through establishment of fruits and vegetable processing units and helps in curtailing migration of rural population to urban area. Finally horticulture has tremendous export potential especially with value added activity and horticulture development could be looked upon as means of earning foreign exchange for the country.

India has witnessed voluminous increase in horticulture production over the last few years. Significant progress has been made in area expansion resulting in higher production. The production of horticultural crops was about 283.5 million tonnes from an area of 2.42 million hectares during 2015-16.

The production of horticultural crops in Andhra Pradesh was 17.32 million tonnes from an area of 1.35 million hectares during 2015-16. Major share of production is from vegetables (51 per cent) and fruits (40 per cent). Andhra Pradesh is a leading lime/lemon producing state in the country with a production of 0.69 million tonnes from 0.05 million hectares with productivity of 15 tonnes per hectare. The state contributes about 33 per cent of total production of lime/lemon in the country. Acid lime is grown in almost all the districts of Andhra Pradesh and the largest area is in semi-arid

regions of Nellore, YSR Kadapa, Prakasham, Guntur, West Godhavari, East Godhavari and Anantapur districts. 13.67 lakh tonnes of citrus have been traded in organized markets with an average price of ₹ 6.83 per kg.

The present study entitled "An Economic analysis of acid lime cultivation in Nellore district of Andhra Pradesh with special reference to variety Balaji" was intended to examine the cost structure and financial viability in the cultivation of acid lime orchards of balaji and local varieties.

5.1 THE OBJECTIVES OF THE STUDY

1. To study the investment pattern in the establishment and maintenance of acid lime orchards.
2. To compare the costs and returns of acid lime variety balaji with other varieties.
3. To study the financial viability of acid lime orchards and
4. To identify the production and marketing constraints in the cultivation of balaji acid lime.

Nellore district that ranks first in area and production of acid lime in Andhra Pradesh was purposively selected for the present study. Four mandals namely Rapur, Kaluvayi, Chejerla and Podalkur that ranked first, second, third and fourth in area under acid lime cultivation was purposively choosen. Two villages from each mandal having both balaji and local varieties were selected at random. From each of the selected villages, 5 farmers each from balaji and local varieties were selected at random. Thus 40 farmers each from balaji and local varieties constituted the sample for the study. The required data pertaining to the cultivation of acid lime orchards were collected from the selected respondents on well-structured survey schedule designed for the purpose for the agriculture year 2015-2016. The data were analyzed to fulfill the objectives by using conventional and project evaluation techniques.

5.2 MAJOR FINDINGS OF THE STUDY

The socio-economic profile of the acid lime orchardists revealed that the average size of the family was 5.02 and 5.22 members on the farms of balaji and local varieties respectively. There is no marked difference in the average size of the family between the two categories of acid lime orchardists. The number of the family members working on the farm was 2.42 and 2.37 on the above said categories of farms in the same order.

The average size of holding was in the order of 3.5 and 5.5 hectares on the farms of balaji and local varieties respectively. The area under irrigated dry land both in absolute and relative terms was more on local variety farms. However, the area under wet land was more on balaji variety farms compared to local variety farms. It is also found that the area under acid lime on balaji variety farms (2.17 ha) was more than that of local variety farms (2.05 ha).

The investment pattern indicated that the land was the single most valuable asset on the sample farms. Land value was to the extent of 94.57 per cent of the value of the total farm assets on local variety farms and 88.42 per cent on balaji variety farms. The value of livestock occupied second place claiming 8.84 per cent and 2.85 per cent of the value of total assets on the acid lime orchards of balaji and local varieties respectively. Next in the order were value of machinery and equipment and value of farm buildings accounting for 2.58, 0.16, 2.49 and 0.9 per cent of total value of assets on the aforesaid varieties of farms.

Total human labour used for the establishment of acid lime orchards of balaji and local varieties for the entire pre-bearing period (1-3 years) was 576.50 mandays and 522.55 mandays per hectare respectively. During the pre-beaing period, weeding was the most labour consuming operation with 109 man days per hectare accounting for 18.91 per cent of the total labour

used on balaji variety orchards. The same was 96 mandays accounting for 18.37 per cent on local variety farms. Fence maintenance, clearing of basins, irrigation and the application of manures and fertilizers accounting for 15.61, 13.87, 10.40 and 10.76 per cent on balaji variety farms and 17.22, 11.48, 8.61 and 11.87 per cent of total labour on local variety farms respectively.

About 5,594.69 and 4,857.83 mandays of human labour per hectare were employed from the 4th year to 15th year of acid lime orchards on balaji and local variety farms respectively. Major labour absorbing operation during the bearing period was harvesting which required 1,738 mandays and 1,172.5 mandays per hectare on the farms of balaji and local varieties respectively. This operation accounted for 31.06 per cent and 24.14 per cent of the total labour used on the aforesaid farms. The next labour consuming operation was irrigation towards which 915 man days (16.36%) were used on balaji variety farms. The same on local variety farms was 684 mandays per hectare accounting for 14.08 per cent of the total labour employed from 4th to 15th year. Application of manures and fertilizers was the third important operation in the cultivation of acid lime orchards for which the orchardists of balaji variety and local variety employed 666.6 mandays (11.92%) and 776 mandays (15.99%) per hectare respectively. Weeding required 609 mandays and 573 mandays per hectare on the aforesaid farms. Out of total labour utilization during bearing period family labour contribution was 707.75 mandays (12.65%) and 657.58 mandays (13.54%) on the acid lime orchards of balaji and local varieties respectively.

The total human labour requirement for the cultivation of acid lime orchard for the entire 15 years period (1st- 15th year), stood at 6171.19 mandays and 5380.38 mandays per hectare on balaji and local variety farms respectively. Harvesting was the operation that absorbed maximum human labour. It was 1738 and 1172.5 mandays per hectare accounting for 28.17 per cent and 21.79 per cent on the aforesaid varieties of farms. The other

important labour consuming operations were irrigation (975 and 729 mandays), application of manures and fertilizers (728.6 and 838 mandays) and weeding (718 and 669 mandays) on balaji and local varieties orchards.

Orchards of balaji and local varieties utilized 229.92 hours and 218.5 hours of machine power per hectare respectively for the entire 15 years period. This included pre-bearing and bearing periods. Transportation utilized maximum machinery services accounting for 70.65 per cent 66.25 per cent of the total machinery power employed on the farms of balaji and local varieties respectively.

A plant population of 225 per hectare was maintained each on the balaji and local varieties farms. The total quantity of manures applied from 1 to 15 years was 466.5 tonnes and 440.5 tonnes per hectare on the above said varieties of acid lime orchards. The use of fertilizers viz., urea, phosphate and potash was 1880 kg, 6250 kg and 1250 kg per hectare each on the balaji and local varieties farms for the entire 15 years period.

The per hectare total cost incurred during pre-bearing period (from 1st to 3rd year) of acid lime orchard stood at ₹ 2,60,003 and ₹ 2,48,886 per hectare on balaji and local varieties farms respectively. Out of total costs, operational and fixed cost worked out to ₹ 2,04,197 (78.54%) and ₹ 5,50,806 (21.46%), ₹ 1,90,386 (76.49%) and ₹ 58,500 (23.51%) on above said varieties of farms respectively. The major item of expenditure was human labour towards which orchardists of balaji and local varieties spent ₹ 1,15,300 (44.34%) and ₹ 1,04,510 (41.99%) per hectare respectively. The opportunity cost on owned land was the second major item of expenditure amounting to ₹ 37,500 each on balaji and local varieties farms.

The total costs incurred from 4th to 15th year were ₹ 24,87,200.40 and ₹ 22,00,066.82 per hectare on the acid lime orchards of balaji and local varieties respectively. The operational and fixed costs were worked out to be

₹ 18,02,976 (72.48%) and ₹ 6,84,224 (27.52%) per hectare on balaji variety farms respectively. The same were ₹ 15,91,515.62 (72.33%) and ₹ 6,08,552 (27.67%) per hectare on the local variety acid lime orchards respectively. Human labour formed the major item of the expenditure amounting to ₹ 1,11,938 and ₹ 9,71,566 per hectare accounting for 44.98 per cent and 44.10 per cent of the total costs on balaji and local varieties farms respectively. Rental value of owned land was the next important cost component accounting for 18.29 and 19.33 per cent of the total costs incurred from 4th to 15th year on balaji and local variety farms respectively.

The total costs for the entire 15 years period of the acid lime orchard worked out to be ₹ 24,87,200.40 on balaji variety farms against ₹ 22,00,066.62 on local variety farms. The breakup of total costs into operational and fixed costs indicated that the operational costs were ₹ 18,02,976 and ₹ 15,91,515.62 per hectare and fixed costs ₹ 6,84,224 and ₹ 6,08,552 per hectare on the farms of balaji and local varieties respectively. Of the total costs, human labour was the highest item of costs with ₹ 11,18,938 (44.98%) on the balaji variety farms and ₹ 9,71,566 (44.16%) per hectare on the local variety farms. Rental value of the owned land was the other major item of expenditure amounting to ₹ 4,55,000 (18.29%) and ₹ 4,25,000 (19.33%) per hectare on the acid lime orchards of balaji and local varieties respectively. Orchardists of balaji and local varieties incurred an amount of ₹ 2,91,030 and ₹ 2,76,030 per hectare respectively on the purchase of manures and fertilizers. This item of expenditure accounted for 11.69 and 12.54 per cent of the total costs on the aforesaid varieties of acid lime orchards.

The per hectare gross income on acid lime orchard from 4th to 15th year was ₹ 40,30,000 and ₹ 32,30,000 per hectare on balaji and local varieties farms respectively. The net income obtained from a hectare of acid lime orchard for the entire bearing period that is from 4th to 15th year on balaji and local varieties farms stood at ₹ 12,82,797.00 and ₹ 7,81,047.40

respectively. The orchardists of balaji and local varieties produced 1612 quintals and 1292 quintals of output per hectare respectively for the 12 years bearing period.

The growers of balaji and local varieties of acid lime incurred ₹ 1,542.93 and ₹ 1,702.83 to produce a quintal of output. A net income of ₹ 957.07 and ₹ 797.17 per quintal was realized by the acid lime orchardists of balaji and local varieties respectively.

To study the financial viability of acid lime orchards of balaji and local varieties, net present worth, benefit-cost ratio and internal rate of return were calculated at 12, 16, 18, 20 and 24 per cent discount rates. Even at the higher discounts rate of 24 per cent, the calculated net present worth and benefit cost ratio were as high as ₹ 95,149.59 and ₹ 5,878.26, 1.25 and 1.01 on balaji and local variety farms respectively. Internal rate of returns was calculated at 33.17 and 24.60 per cent on the above said farms in the same order. The internal rate of return on both the varieties of farms was higher than the borrowed rate of interest.

The major production and marketing problems of acid lime growers were high degree of perishability, low prices and price volatility and lack of regulated market.

5.3 CONCLUSIONS

1. There is no marked difference between balaji and local varieties of acid lime orchards with respect to size of the family as well as family members working on the farm.

2. The average size of land holding was higher on the farms of local variety compared to the farms of balaji variety.

3. Both in absolute and relative terms the area under acid lime of balaji variety was higher than that of local variety.

4. On an average, the value of assets possessed by the orchardists of balaji variety was marginally higher than the value of assets possessed by the growers of local variety.

5. The total labour requirement for the cultivation of acid lime orchards of balaji and local varieties stood at 6171.19 and 5380.38 mandays per hectare respectively for the entire 15 years period which includes both pre-bearing and bearing periods. .

6. Harvesting, application of manures and fertilizers, irrigation, fence maintenance were the major labour absorbing operations.

7. The per hectare total costs for the 15 years period of the acid lime orchard worked out to ₹ 22,00,066.62 on local variety farms as against ₹ 24,87,200.40 on balaji variety farms.

8. Human labour, Rental value of owned land and manures and fertilizers were the major items in the cost structure of acid lime orchards of both the varieties.

9. The net income obtained by growers of balaji variety (₹ 12,82,797.00) was more than the net income obtained by the growers of local variety (₹ 7,81,047.40).

10. The orchardists of local variety incurred more expenditure (₹ 1,702.83) than the orchardists of balaji variety (₹ 1,542.93) to produce a quintal of acid lime.

11. The project evaluation indicated the economic viability of both the varieties of acid lime orchard even at higher discount rate (24%).

12. The net present value and benefit cost ratio were higher on balaji variety farms over local variety farms reflecting higher productivity of capital on the acid lime orchards of balaji variety.

13. Price fluctuations, high degree of perishability and lack of regulated market were the major problems associated with the production and marketing of acid lime.

The acid lime growers were unaware of the importance of maintaining optimum plant population and application of nutrients in required doses and hence the Department of horticulture has to play an important role in educating the orchardists in adopting the package of practices. Capital productivity was more on balaji variety farms compared to local variety farms as indicated by the project evaluation techniques. Hence, the Department of horticulture can encourage the orchardists to increase the area under balaji variety.

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Appendices

Estimates of Economic Viability of Acid Lime Orchard : Local variety (8 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	64360.00	0.00	-64360.00	0.9259	59590.92	0.00	-59590.92
2	51360.00	0.00	-51360.00	0.8573	44030.93	0.00	-44030.93
3	61462.00	0.00	-61462.00	0.7938	48788.54	0.00	-48788.54
4	86100.00	24000.00	-62100.00	0.735	63283.50	17640.00	-45643.50
5	100450.00	76000.00	-24450.00	0.6806	68366.27	51725.60	-16640.67
6	106403.00	120000.00	13597.00	0.6302	67055.17	75624.00	8568.83
7	108727.00	170000.00	61273.00	0.5835	63442.20	99195.00	35752.80
8	116947.00	220000.00	103053.00	0.5403	63186.46	118866.00	55679.54
9	131447.00	270000.00	138553.00	0.5002	65749.79	135054.00	69304.21
10	133302.00	300000.00	166698.00	0.4632	61745.49	138960.00	77214.51
11	133302.00	350000.00	216698.00	0.4289	57173.23	150115.00	92941.77
12	139427.00	350000.00	210573.00	0.3971	55366.46	138985.00	83618.54
13	144427.00	450000.00	305573.00	0.3677	53105.81	165465.00	112359.19
14	147627.00	500000.00	352373.00	0.3405	50266.99	170250.00	119983.01
15	132627.00	400000.00	267373.00	0.3152	41804.03	126080.00	84275.97

Estimates of Economic Viability of Local Acid Lime Orchard: Local variety (12 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	64360.00	0.00	-64360.00	0.8929	57464.29	0.00	-57464.29
2	51360.00	0.00	-51360.00	0.7972	40943.88	0.00	-40943.88
3	61462.00	0.00	-61462.00	0.7118	43747.44	0.00	-43747.44
4	86100.00	24000.00	-62100.00	0.6355	54718.11	15252.43	-39465.67
5	100450.00	76000.00	-24450.00	0.5674	56998.03	43124.44	-13873.59
6	106403.00	120000.00	13597.00	0.5066	53907.07	60795.73	6888.66
7	108727.00	170000.00	61273.00	0.4523	49182.57	76899.37	27716.79
8	116947.00	220000.00	103053.00	0.4039	47232.93	88854.31	41621.38
9	131447.00	270000.00	138553.00	0.3606	47401.11	97364.71	49963.60
10	133302.00	300000.00	166698.00	0.3220	42919.68	96591.97	53672.29
11	133302.00	350000.00	216698.00	0.2875	38321.14	100616.64	62295.50
12	139427.00	350000.00	210573.00	0.2567	35787.44	89836.28	54048.84
13	144427.00	450000.00	305573.00	0.2292	33098.94	103128.39	70029.44
14	147627.00	500000.00	352373.00	0.2046	30207.41	102309.91	72102.50
15	132627.00	400000.00	267373.00	0.1827	24230.46	73078.50	48848.05

Estimates of Economic Viability of Local Acid Lime Orchard: Local variety (16 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	64360.00	0.00	-64360.00	0.8621	55482.76	0.00	-55482.76
2	51360.00	0.00	-51360.00	0.7432	38168.85	0.00	-38168.85
3	61462.00	0.00	-61462.00	0.6407	39376.10	0.00	-39376.10
4	86100.00	24000.00	-62100.00	0.5523	47552.26	13254.99	-34297.28
5	100450.00	76000.00	-24450.00	0.4761	47825.55	36184.59	-11640.96
6	106403.00	120000.00	13597.00	0.4104	43672.29	49253.07	5580.78
7	108727.00	170000.00	61273.00	0.3538	38470.82	60151.02	21680.20
8	116947.00	220000.00	103053.00	0.3050	35671.81	67105.60	31433.79
9	131447.00	270000.00	138553.00	0.2630	34564.38	70997.30	36432.92
10	133302.00	300000.00	166698.00	0.2267	30217.38	68005.08	37787.70
11	133302.00	350000.00	216698.00	0.1954	26049.46	68395.91	42346.45
12	139427.00	350000.00	210573.00	0.1685	23488.27	58962.00	35473.73
13	144427.00	450000.00	305573.00	0.1452	20974.64	65351.97	44377.32
14	147627.00	500000.00	352373.00	0.1252	18482.21	62597.67	44115.46
15	132627.00	400000.00	267373.00	0.1079	14314.04	43170.81	28856.77

Estimates of Economic Viability of Local Acid Lime Orchard: Local variety (18 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	64360.00	0.00	-64360.00	0.8475	54542.37	0.00	-54542.37
2	51360.00	0.00	-51360.00	0.7182	36885.95	0.00	-36885.95
3	61462.00	0.00	-61462.00	0.6086	37407.67	0.00	-37407.67
4	86100.00	24000.00	-62100.00	0.5158	44409.42	12378.93	-32030.49
5	100450.00	76000.00	-24450.00	0.4371	43907.62	33220.30	-10687.32
6	106403.00	120000.00	13597.00	0.3704	39415.03	44451.78	5036.76
7	108727.00	170000.00	61273.00	0.3139	34132.13	53367.26	19235.13
8	116947.00	220000.00	103053.00	0.2660	31112.37	58528.40	27416.03
9	131447.00	270000.00	138553.00	0.2255	29635.52	60873.14	31237.62
10	133302.00	300000.00	166698.00	0.1911	25469.28	57319.34	31850.06
11	133302.00	350000.00	216698.00	0.1619	21584.13	56671.66	35087.53
12	139427.00	350000.00	210573.00	0.1372	19132.11	48026.83	28894.73
13	144427.00	450000.00	305573.00	0.1163	16795.09	52329.48	35534.39
14	147627.00	500000.00	352373.00	0.0985	14548.48	49274.46	34725.98
15	132627.00	400000.00	267373.00	0.0835	11076.48	33406.42	22329.93

Estimates of Economic Viability of Local Acid Lime Orchard: Local variety (20 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	64360.00	0.00	-64360.00	0.8333	53633.33	0.00	-53633.33
2	51360.00	0.00	-51360.00	0.6944	35666.67	0.00	-35666.67
3	61462.00	0.00	-61462.00	0.5787	35568.29	0.00	-35568.29
4	86100.00	24000.00	-62100.00	0.4823	41521.99	11574.07	-29947.92
5	100450.00	76000.00	-24450.00	0.4019	40368.60	30542.70	-9825.91
6	106403.00	120000.00	13597.00	0.3349	35634.15	40187.76	4553.61
7	108727.00	170000.00	61273.00	0.2791	30343.71	47443.88	17100.17
8	116947.00	220000.00	103053.00	0.2326	27198.13	51164.97	23966.83
9	131447.00	270000.00	138553.00	0.1938	25475.31	52327.81	26852.50
10	133302.00	300000.00	166698.00	0.1615	21529.02	48451.67	26922.66
11	133302.00	350000.00	216698.00	0.1346	17940.85	47105.80	29164.95
12	139427.00	350000.00	210573.00	0.1122	15637.67	39254.83	23617.16
13	144427.00	450000.00	305573.00	0.0935	13498.71	42058.75	28560.04
14	147627.00	500000.00	352373.00	0.0779	11498.16	38943.28	27445.12
15	132627.00	400000.00	267373.00	0.0649	8608.22	25962.19	17353.97

Estimates of Economic Viability of Local Acid Lime Orchard: Local variety (24 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	64360.00	0.00	-64360.00	0.8065	51903.23	0.00	-51903.23
2	51360.00	0.00	-51360.00	0.6504	33402.71	0.00	-33402.71
3	61462.00	0.00	-61462.00	0.5245	32236.04	0.00	-32236.04
4	86100.00	24000.00	-62100.00	0.4230	36418.03	10151.37	-26266.66
5	100450.00	76000.00	-24450.00	0.3411	34264.27	25924.19	-8340.08
6	106403.00	120000.00	13597.00	0.2751	29270.07	33010.43	3740.36
7	108727.00	170000.00	61273.00	0.2218	24120.46	37713.52	13593.06
8	116947.00	220000.00	103053.00	0.1789	20922.60	39359.47	18436.87
9	131447.00	270000.00	138553.00	0.1443	18965.12	38955.48	19990.37
10	133302.00	300000.00	166698.00	0.1164	15510.29	34906.35	19396.06
11	133302.00	350000.00	216698.00	0.0938	12508.30	32841.99	20333.70
12	139427.00	350000.00	210573.00	0.0757	10550.83	26485.48	15934.65
13	144427.00	450000.00	305573.00	0.0610	8813.87	27461.90	18648.03
14	147627.00	500000.00	352373.00	0.0492	7265.44	24607.44	17341.99
15	132627.00	400000.00	267373.00	0.0397	5263.89	15875.77	10611.88

Estimates of Economic Viability of Local Acid Lime Orchard: Balaji variety (8 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	61222.00	0.00	-61222.00	0.9259	56685.45	0.00	-56685.45
2	60269.00	0.00	-60269.00	0.8573	51668.61	0.00	-51668.61
3	68537.00	0.00	-68537.00	0.7938	54404.67	0.00	-54404.67
4	91040.00	100000.00	8960.00	0.7350	66914.40	73500.00	6585.60
5	118434.00	126000.00	7566.00	0.6806	80606.18	85755.60	5149.42
6	121367.00	174000.00	52633.00	0.6302	76485.48	109654.80	33169.32
7	110363.00	230000.00	119637.00	0.5835	64396.81	134205.00	69808.19
8	131323.00	280000.00	148677.00	0.5403	70953.82	151284.00	80330.18
9	143003.00	320000.00	176997.00	0.5002	71530.10	160064.00	88533.90
10	145108.00	320000.00	174892.00	0.4632	67214.03	148224.00	81009.97
11	150108.00	400000.00	249892.00	0.4289	64381.32	171560.00	107178.68
12	158426.00	400000.00	241574.00	0.3971	62910.96	158840.00	95929.04
13	173426.00	600000.00	426574.00	0.3677	63768.74	220620.00	156851.26
14	176563.00	600000.00	423437.00	0.3405	60119.70	204300.00	144180.30
15	158083.00	440000.00	281917.00	0.3152	49827.76	138688.00	88860.24

Estimates of Economic Viability of Local Acid Lime Orchard: Balaji variety (12 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	61222.00	0.00	-61222.00	0.8929	54662.50	0.00	-54662.50
2	60269.00	0.00	-60269.00	0.7972	48046.08	0.00	-48046.08
3	68537.00	0.00	-68537.00	0.7118	48783.28	0.00	-48783.28
4	91040.00	100000.00	8960.00	0.6355	57857.57	63551.81	5694.24
5	118434.00	126000.00	7566.00	0.5674	67202.63	71495.78	4293.15
6	121367.00	174000.00	52633.00	0.5066	61488.30	88153.82	26665.52
7	110363.00	230000.00	119637.00	0.4523	49922.62	104040.32	54117.70
8	131323.00	280000.00	148677.00	0.4039	53039.16	113087.30	60048.15
9	143003.00	320000.00	176997.00	0.3606	51568.32	115395.21	63826.89
10	145108.00	320000.00	174892.00	0.3220	46720.89	103031.44	56310.54
11	150108.00	400000.00	249892.00	0.2875	43152.46	114990.44	71837.98
12	158426.00	400000.00	241574.00	0.2567	40664.01	102670.04	62006.03
13	173426.00	600000.00	426574.00	0.2292	39744.76	137504.51	97759.75
14	176563.00	600000.00	423437.00	0.2046	36128.29	122771.89	86643.60
15	158083.00	440000.00	281917.00	0.1827	28881.17	80386.35	51505.18

Estimates of Economic Viability of Local Acid Lime Orchard: Balaji variety (16 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	61222.00	0.00	-61222.00	0.8621	52777.59	0.00	-52777.59
2	60269.00	0.00	-60269.00	0.7432	44789.68	0.00	-44789.68
3	68537.00	0.00	-68537.00	0.6407	43908.75	0.00	-43908.75
4	91040.00	100000.00	8960.00	0.5523	50280.58	55229.11	4948.53
5	118434.00	126000.00	7566.00	0.4761	56387.97	59990.24	3602.27
6	121367.00	174000.00	52633.00	0.4104	49814.15	71416.95	21602.81
7	110363.00	230000.00	119637.00	0.3538	39049.69	81380.79	42331.10
8	131323.00	280000.00	148677.00	0.3050	40056.86	85407.13	45350.27
9	143003.00	320000.00	176997.00	0.2630	37603.07	84144.95	46541.89
10	145108.00	320000.00	174892.00	0.2267	32893.60	72538.75	39645.15
11	150108.00	400000.00	249892.00	0.1954	29333.64	78166.76	48833.12
12	158426.00	400000.00	241574.00	0.1685	26688.89	67385.14	40696.24
13	173426.00	600000.00	426574.00	0.1452	25186.07	87135.95	61949.89
14	176563.00	600000.00	423437.00	0.1252	22104.86	75117.20	53012.34
15	158083.00	440000.00	281917.00	0.1079	17061.43	47487.89	30426.46

Estimates of Economic Viability of Local Acid Lime Orchard: Balaji variety (18 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	61222.00	0.00	-61222.00	0.8475	51883.05	0.00	-51883.05
2	60269.00	0.00	-60269.00	0.7182	43284.26	0.00	-43284.26
3	68537.00	0.00	-68537.00	0.6086	41713.73	0.00	-41713.73
4	91040.00	100000.00	8960.00	0.5158	46957.42	51578.89	4621.47
5	118434.00	126000.00	7566.00	0.4371	51768.59	55075.76	3307.17
6	121367.00	174000.00	52633.00	0.3704	44958.16	64455.09	19496.92
7	110363.00	230000.00	119637.00	0.3139	34645.71	72202.76	37557.05
8	131323.00	280000.00	148677.00	0.2660	34936.93	74490.69	39553.76
9	143003.00	320000.00	176997.00	0.2255	32240.89	72145.94	39905.05
10	145108.00	320000.00	174892.00	0.1911	27724.98	61140.63	33415.65
11	150108.00	400000.00	249892.00	0.1619	24305.34	64767.62	40462.27
12	158426.00	400000.00	241574.00	0.1372	21739.14	54887.81	33148.67
13	173426.00	600000.00	426574.00	0.1163	20167.32	69772.64	49605.32
14	176563.00	600000.00	423437.00	0.0985	17400.09	59129.36	41729.26
15	158083.00	440000.00	281917.00	0.0835	13202.47	36747.06	23544.59

Estimates of Economic Viability of Local Acid Lime Orchard: Balaji variety (20 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	61222.00	0.00	-61222.00	0.8333	51018.33	0.00	-51018.33
2	60269.00	0.00	-60269.00	0.6944	41853.47	0.00	-41853.47
3	68537.00	0.00	-68537.00	0.5787	39662.62	0.00	-39662.62
4	91040.00	100000.00	8960.00	0.4823	43904.32	48225.31	4320.99
5	118434.00	126000.00	7566.00	0.4019	47595.97	50636.57	3040.61
6	121367.00	174000.00	52633.00	0.3349	40645.56	58272.25	17626.69
7	110363.00	230000.00	119637.00	0.2791	30800.29	64188.78	33388.49
8	131323.00	280000.00	148677.00	0.2326	30541.53	65119.05	34577.52
9	143003.00	320000.00	176997.00	0.1938	27714.94	62018.14	34303.20
10	145108.00	320000.00	174892.00	0.1615	23435.75	51681.79	28246.03
11	150108.00	400000.00	249892.00	0.1346	20202.73	53835.19	33632.46
12	158426.00	400000.00	241574.00	0.1122	17768.53	44862.66	27094.13
13	173426.00	600000.00	426574.00	0.0935	16209.07	56078.33	39869.26
14	176563.00	600000.00	423437.00	0.0779	13751.89	46731.94	32980.05
15	158083.00	440000.00	281917.00	0.0649	10260.45	28558.41	18297.96

Estimates of Economic Viability of Local Acid Lime Orchard: Balaji variety (24 per cent discount rate)

Years	Costs	Benefits	Net benefits	Discount rate factor	Present worth of costs	Present worth of benefits	Net present worth
1	61222.00	0.00	-61222.00	0.8065	49372.58	0.00	-49372.58
2	60269.00	0.00	-60269.00	0.6504	39196.80	0.00	-39196.80
3	68537.00	0.00	-68537.00	0.5245	35946.78	0.00	-35946.78
4	91040.00	100000.00	8960.00	0.4230	38507.52	42297.36	3789.84
5	118434.00	126000.00	7566.00	0.3411	40398.75	42979.58	2580.82
6	121367.00	174000.00	52633.00	0.2751	33386.47	47865.12	14478.65
7	110363.00	230000.00	119637.00	0.2218	24483.40	51024.18	26540.78
8	131323.00	280000.00	148677.00	0.1789	23494.56	50093.87	26599.31
9	143003.00	320000.00	176997.00	0.1443	20632.41	46169.46	25537.05
10	145108.00	320000.00	174892.00	0.1164	16883.97	37233.44	20349.47
11	150108.00	400000.00	249892.00	0.0938	14085.27	37533.71	23448.43
12	158426.00	400000.00	241574.00	0.0757	11988.54	30269.12	18280.58
13	173426.00	600000.00	426574.00	0.0610	10583.57	36615.87	26032.30
14	176563.00	600000.00	423437.00	0.0492	8689.53	29528.93	20839.40
15	158083.00	440000.00	281917.00	0.0397	6274.22	17463.34	11189.12