ECONOMIC ANALYSIS OF PRODUCTION AND PROCESSING OF OIL PALM IN NELLORE DISTRICT OF ANDHRA PRADESH

By

CHALLA SRILATHA, B Sc., (Ag.)

THESIS SUBMITTED TO THE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF

MASTER OF SCIENCE IN AGRICULTURE
(AGRICULTURAL ECONOMICS)

DEPARTMENT OF AGRICULTURAL ECONOMICS
SRI VENKATESWARA AGRICULTURAL COLLEGE
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CERTIFICATE

Miss. Ch. Srilatha, has satisfactorily prosecuted the course of research and that the thesis entitled **"ECONOMIC ANALYSIS OF PRODUCTION AND PROCESSING OF OIL PALM IN NELLORE DISTRICT OF ANDHRA PRADESH"** 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 the thesis or part thereof has not been previously submitted by her for a degree of any University.

Date : 23.11.2000

Major Advisor

I. Bhavani Devi
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CERTIFICATE

This is to certify that the thesis entitled **"ECONOMIC ANALYSIS OF PRODUCTION AND PROCESSING OF OIL PALM IN NELLORE DISTRICT OF ANDHRA PRADESH"** submitted in partial fulfilment of the requirements for the degree of **'MASTER OF SCIENCE IN AGRICULTURE'** of the Acharya N.G.Ranga Agricultural University, Hyderabad is a record of the bonafide research work carried out by **Miss CH. SRILATHA,** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

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

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23.11.2000

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DECLARATION

I, **Miss. CH. SRILATHA,** hereby declare that the thesis entitled **""ECONOMIC ANALYSIS OF PRODUCTION AND PROCESSING OF OIL PALM IN NELLORE DISTRICT OF ANDHRA PRADESH"** is a result of original research work done by me. It is further declared that no thesis or any part thereof has not been published earlier in any manner.

Ch. Srilatha

Date : 23-11-2000 **(CH. SRILATHA)**

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ABSTRACT

Author	:	**CH. SRILATHA**
Title of thesis	:	**ECONOMIC ANALYSIS OF PRODUCTION AND PROCESSING OF OIL PALM IN NELLORE DISTRICT OF ANDHRA PRADESH**
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The present study entitled **"Economic Analysis of Production and Processing of Oil Palm in Nellore District of Andhra Pradesh"** was undertaken mainly to study costs and returns, economic viability and processing aspects of oil palm. Nellore district was purposively chosen for the study as it has considerable area under oil palm. All the mandals in Nellore district growing oil palm were arranged in descending order of the area under the crop and top three mandals were chosen purposively. Two villages from each selected mandal were chosen purposively using the above criterion making the number of sample villages to six. All the farmers in the selected villages growing oil palm were divided into two groups namely pre bearing orchards upto the age of 4 years and bearing orchards with the age above 4 years. An ultimate sample of 60 (30+30) oil palm growers covering the above two groups were chosen randomly based on multistage stratified sampling technique. The information pertaining to oil palm processing was collected from the lone processing unit located at Manubolu of Nellore district.

Tabular analysis and discounted project evaluation techniques were used to study costs, returns, processing aspects and economic feasibility of the oil palm orchard respectively.

The total labour required to establish and maintain the oil palm orchard during its economic life period was 2,485.52 man days per hectare. Harvesting, watch and ward, weeding and interculture were the major labour absorbing cultural practices in the cultivation of oil palm.

The commercial cost of cultivation incurred to raise one hectare of oil palm during its life span of 25 years stood at Rs. 6,33,627.2 and Rs. 6,17,377.2 without and with subsidy respectively. The gross income realised by the oil palm orchardists during its life span amounted to Rs. 9,63,135.09 per hectare which included the net income from intercrops during pre bearing period and from sale of oil palm fresh fruit bunches from third year onwards. The respective net incomes received by the farmers without and with subsidy stood at Rs. 3,29,507.89 and Rs. 3,45,757.89.

The net present value was as high as Rs. 65,201.48 at 12 per cent and Rs. 15,103.41 at 24 per cent discount rates. The benefit-cost ratio was 1.166 even at higher discount rate of 24 per cent. The IRR was calculated at 39.19 per cent. All these measures indicated that the oil palm cultivation is a profitable proposition.

The total costs incurred by the processing unit to produce one tonne of palm oil was Rs. 18,854.29. The gross and net returns obtained in producing one tonne palm oil were Rs. 38,940 and Rs. 20,086.01 respectively.

The problems regarding production of oil palm identified were shortage of power supply, price fluctuations, high input costs, non-availability of high yielding varieties of oil palm, lack of improved farm implements, and lack of adequate credit facilities. The problems faced by the processing unit included non-availability of raw material through out the year and scarcity of labour during peak periods of work. In the light of these facts an integrated approach is a must to meet the target production of oil palm.

INTRODUCTION

CHAPTER - I

INTRODUCTION

India is the third largest edible oil economy in the world after the U.S and China. It occupies a distinct position not only in terms of area under oil seeds but also in terms of diversity in cultivated oil seeds. India holds a premier position in the global oil seeds scenario accounting for 19 per cent of the total area and 9 per cent of production. However the productivity in India is only 935 kg/ha (1998-99) as compared to world level of 1,632 kg/ha. Oil seeds share 14 per cent of the country's gross cropped area and account for nearly 5 per cent of the gross national product and 10 per cent of the value of all agricultural products. About 14 million persons are engaged in the production of oil seeds and another one million in their processing. India is the world's largest producer of sesame and castor and second largest producer of groundnut and rapeseed and mustard next to China (Hedge 2000).[1]

Since 1950-51, the oil seed area, production and productivity have increased nearly 2.5 times, 5 times and 2 times respectively. The dramatic transformation of the Indian oil seeds economy from a net importer status in the eighties to a self sufficient and more so a net exporter status during the early nineties has been popularly termed as

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1. Hedge DM (2000). Technology for high yields. The Hindu Survey of Indian Agriculture.

Yellow Revolution. From a mere 11 million tonnes during 1986-87 the country attained an all time record oil seed production of 25 million tonnes during 1996-97 just in the span of a decade.

The annual per capita availability of edible oil and vanaspati has increased from 4 kg during 1960-61 to 8.2 kg during 1995-96. The Indian Council of Medical Research has recommended an intake rate of 20 gm per adult per day (7.3 kg per year). At this rate the total oil requirement by 2020 AD will be 10.495 million tonnes which could be extracted from 34.636 million tonnes of edible oil seeds on the assumption of 33% of recovery across all the oil seeds. However, the edible oil consumption is highly income elastic. It is estimated that the annual demand for vegetable oils may grow at the rate of 5.5 to 6 per cent in the next 10 years if our GDP growth rate is maintained at 4 per cent per annum.

The oil seed sector plays an important role in International Trade. The export of oil seeds and minor oils / fats during 1996-97 is reported to be about 4.55 million tonnes valued at over Rs. 3,700 crores. On the import front, after edible oils were placed in the Open General Licence, there has been a steep escalation in the quantities imported from under four lakh tonnes in 1994 to about a million tonnes in 1996 and over 1.75 million tonnes valued at over Rs. 3,000 crores during 1997. Always there

has been a steep rise in quantities of edible oil imported, since 1994. The value of exports always more than the import bill since 1997-98. This was reversed in 1998-99 due to the import of 45 lakh tonnes of edible oil valued at Rs. 9000 crores while the export earning were much lower due to depressed price in the International Market. Polmolein accounted for 80 per cent of the imports (Hegde and Kiresur 1999).[2]

The Technology Mission on oil seeds came into being in May 1986 with a mandate to accelerate the efforts towards self reliance in edible oils and reduce dependence on imports. However, despite increased production of vegetable oils in the country the gap between the demand and supply has been widening due to increase in population and rise in income levels resulting in large import of vegetable oils, causing a drain on valuable foreign exchange.

The minor and tree origin oil seeds which contribute about 16 per cent of the vegetable oil consumption in the country have tremendous oil potential which needs to be fully tapped. As of now, only about 45 per cent of the potential (3.08 million tonnes) of these non traditional oil sources is exploited (1995-96). The balance of which could provide a sizable quantity of edible / non-edible oils and reduce the gap between demand and supply. Oil palm is another potential source of edible oil

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2. Hegde DM and Kiresur V (1999) Changing Paradigms. The Hindu Survey of Indian Agriculture.

expected to contribute significantly towards meeting the growing edible oil demand (Hegde and Kiresur 1999).

Of all the known oil yielding crops, oil palm ranks first with a production of about 6 tonnes of oil / ha / year. Oil palm produces 22 per cent of the World's Vegetable Oil on only 2 per cent of the land planted to major vegetable oils (Fig 1.1). (Fairhurst and Muier 1999).[3] This oil palm production can be used to achieve self sufficiency in edible oil and save the financial drain on the imports of edible oils. Being a perennial crop, oil palm can stabilise the production of oil for several decades to come.

Red oil palm, botanically known as *Elacis guineensis* was originally found on the Guinea coast of West Africa. During 1900, the oil palm was planted in Sumatra Islands to serve ornamental value in the tobacco gardens. The commercial aspects of oil palm unfolded in 1910, in 1911 oil palm plantations began coming up. The Indonesia took up commercial planting in 1915 and Malaysia in 1917.

Oil palm is cultivated in roughly 5.76 million hectares across the world to yield 17.45 million tonnes of oil. Malaysia and Indonesia are

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3. Fairhurst T.H and Mutert E (1999). Introduction to oil palm production. Better crops International, Vol. 13(1) 3-5.

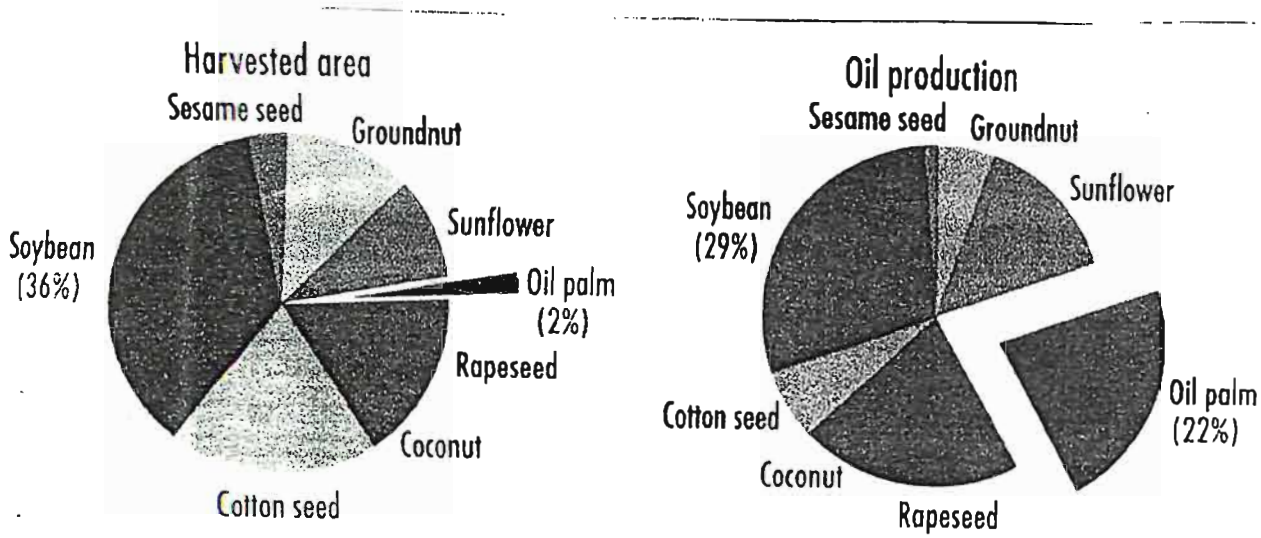

Fig. 1.1 **Harvested area and oil production for major vegetable oil crops Mielke (1991)**

the leaders followed by Nigeria. Besides Malaysia and Indonesia and West African countries, oil palm is grown in Papua, New Guinea, China, Brazil, Columbia, Ecuador, Panama, Costarica, India and other countries in the far East.

Oil palm was first brought to India as a botanical collection at the National Botanical Garden, Calcutta. In recent years, India has been exploring the possibilities of cultivating oil palm. The working group constituted by the Government of India under the chairmanship of Dr.K.L.Chadha, Deputy Director General (Horticulture) ICAR, has identified 5.75 lakh ha during 1987 in nine states of India and subsequently, additional potential areas were identified by the committee under the leadership of Dr.P.Rethinam. As on today, about 0.796 million ha has been identified as potential for growing oil palm under irrigated conditions in the 12 states in the country.

Favourable conditions for successful cultivation of oil palm are in Andaman and Nicobar Islands and some parts of Southern Kerala where the crop is grown as a rainfed crop. In other states like Andhra Pradesh, Karnataka, Tamil Nadu, Goa, Maharastra, Orissa, West Bengal and Assam, this crop can be grown under irrigated conditions. The state wise areas identified are shown in Table 1.1.

Table 1.1 Potential areas for oil palm cultivation in different states of India

States	Area identified			Total (Lakhs ha)
	1986-87	1988-91	1997-98	
	(Lakhs ha)			
Andhra Pradesh	2.50	1.50	0.10	4.10
Assam	0.10	—		0.10
Gujarat	—	0.61		0.61
Goa	—	0.10		0.10
Karnataka	2.50	—		2.50
Kerala	0.05	—		0.05
Maharashtra	0.10	—		0.10
Orissa	0.10	—		0.10
Tamil Nadu	0.25	—	0.05	0.30
Tripura	0.05	—		0.05
West Bengal	0.10	—		0.05
	5.75	**2.21**	**0.15**	**8.11**

Source : Records of A.P. Oil Federation, Pedavegi

Among states, Andhra Pradesh and Karnataka were found to posses the maximum potential for oil palm cultivation with identified areas of 4.1 lakh. ha and 2.5 lakh ha. respectively. Potential areas under oil palm cultivation in Andhra Pradesh are shown in Table 1.2

Table 1.2 : Potential areas for oil palm cultivation in Andhra Pradesh (Hectares)

S.No.	District	No. of Identified Mandals	Total identified area
1.	Srikakulam	27	35000
2.	Vizayanagaram	20	20000
3.	Visakhapatnam	19	1000
4.	East Godavari	28	100000
5.	West Godavari	24	100000
6.	Krishna	27	50000
7.	Guntur	18	20000
8.	Prakasam	45	10000
9.	Nellore	46	35000
10.	Khammam	27	20000
11.	Chittoor	13	10000

Source : Directorate of Horticulture & Oil palm Commissioner, Hyderabad 1998.

In Andhra Pradesh, Nellore district has considerable area under oil palm. There has been gradual increase in area and production of oil palm in Nellore district since 1991 under Oil palm Development Programme. In Nellore district 46 mandals have been identified for oil palm cultivation, and so far an area of 2,766 ha are brought under oil palm cultivation. Nellore is the main district supplying oil palm fresh fruit bunches to lone processing plant located at Manubolu.

The following are the processing centres for processing of oil palm fresh fruit bunches in India.

	Capacity
CPCRI Research Centre, Palode (Kerala)	1 tonne / hr
OPIL, Bharatipuram (Kerala)	12 tonne / hr
AP Oil Fed, Pedavegi	5 tonne / hr
Radhika vegetables oil (P) Ltd, Garividi (AP)	5 tonne / hr
MAC Industries, Ampapuram (AP)	5 tonne / hr
Simhapuri Agro Products, Pv Ltd Nellore (AP)	5 tonne / hr

Attempts are being made to set up one tonne / hr processing facilities in Goa and Gujarat and 10 tonne / hr unit at Aswaraopet (AP) by A.P. Oil Federation.

Source : Records of A.P. Oil Federation Pedavegi.

Problem Statement :

Oil palm is highest oil yielding crop in the vegetable Kingdom. The traditional oil seeds viz, groundnut, mustard, safflower, sunflower, soybean, linseed etc. do not give more than 0.8 to 1.0 tonne of oil / ha/ year. Coconut gives between 1.5 to 2.0 tonnes of oil / ha / year. As against these, oil palm has the potential to yield any where between 3 to 6 tonnes per ha / year of edible oil (Motilal 1996).[4] Thus no oil producing crop can ever compete with oil palm. At present, India is importing palm oil as palmolein to bridge the gap in production and

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4. Motilal V.S. (1996) Oil palm - Sunshine for edible oil scenario National Bank News Review.

consumption of oil. It is therefore necessary to go for cultivation of oil palm extensively to achieve self sufficiency in edible oils. It can also contribute substantially to the nutritional and energy requirements of the masses. It is the crop of the future and a source of health and nutrition, enables diversification, import substitution, value addition, low cost of cultivation, waste utilisation and co-generation (non-conventional energy), besides being eco-friendly and sustainable (Dr.P.Rethinam, 1997). Farmers need to be informed about these benefits so as to increase the area under oil palm.

Even though oil palm is being cultivated in Nellore district since 1991 so far no research work has been undertaken on the economic aspects of oil production and processing. So it is felt necessary to probe into the economic aspects of oil palm production and processing in Nellore district of Andhra Pradesh with the following specific objectives.

OBJECTIVES :

1. To work out costs and returns of oil palm orchards;
2. To study the economic feasibility of oil palm orchards;
3. To estimate the costs and returns of oil plam processing; and
4. To study the production and processing problems of oil palm.

SCOPE OF THE STUDY :

The results of the study would be very useful to the oil palm cultivators and it would indicate whether there is any scope for expanding area under oil palm cultivation. The cost structure gives useful information regarding fixation of the price per unit to the administrators and policy makers.

The results of the Net Present Worth, benefit - cost ratio and Internal Rate of Return tell about the profitability of cultivation and the worthiness of the investment.

The study also throws light on various problems faced by the farmers in production of oil palm fresh fruit bunches and processing problems faced by processing unit. The study of processing plant will help many private organisations and policy makers to know the processing cost and returns.

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. This study was continued to a particular agro-climatic region and hence the conclusions drawn are applicable to that area and to the areas with the similar climatic conditions.

Further, the information obtained and presented in the study on the cost and returns of oil palm is for different years and the sample farmers who normally do not maintain farm records, could answer the questions from their memory recall which are bound to have many inherent limitations. However, cross-checking of the data collected helped in minimising the re-call bias.

PLAN OF THE THESIS :

The thesis is presented in five chapters. In the introductory chapter, the economic importance of oil seeds in general and palm oil in particular, 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 oil palm and other related plantation and oil seed crops. The third chapter deals with the sampling design, methods of collection of data, and economic evaluation techniques employed. The fourth chapter encompasses a critical analyses of the results and discussion. The summary and conclusions emerged from the study form the integral part of the fifth chapter.

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 fields 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.

Though oil palm is an important perennial oil seed crop in the world and India, so far much attention was not bestowed on analysis of economic aspects of this crop. Here in this chapter efforts are being made to review the existing literature on oil palm. Since the literature on oil palm is limitedly available, literature on some related plantation and perennial crops was reviewed in this chapter.

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

2.1 STUDIES ON COST STRUCTURE

2.2 STUDIES ON RETURNS

2.3 STUDIES ON ECONOMIC VIABILITY

2.4 STUDIES ON PROCESSING

2.5 STUDIES ON PROBLEMS OF PRODUCTION AND PROCESSING.

2.1 STUDIES ON COST STRUCTURE

Sharma and Pandey (1972) reported that the cost of cultivation of guava orchard upto the age of fruiting was Rs. 3,964.82. The expenses incurred on raising of orchard were met by the intercropping programme leaving a margin at Rs. 2,302.76.

Singh *et al.* (1974) studied the economics of guava plantation in Allahabad district of Uttar Pradesh covering all stages of growth, i.e., establishment, fully grown and declining stage. The total investment on the establishment of guava orchard upto the age of three years was Rs. 5,107.32 per hectare. The initial investment for first year was Rs. 2,765.17 per hectare of which layout and fencing accounted for highest expenditure of 28.55 per cent followed by labour charges for maintenance (17.45 per cent) and digging of pits (13.95 per cent).

Subramanyam and Mohandass (1982) in their study on economic evaluation of coorg mandarin estimated that the establishment costs amortized over forty years at 11 per cent interest per annum to be Rs. 107.41 per acre. The maintenance cost per year was Rs. 370.46 and the total cost per annum was worked out to Rs. 477.87.

Das (1984) estimated the cost of production of cocount in Kerala at Rs. 1.10/- nut under 1982-83 factor prices but without taking land

revenue into consideration. When a moderate price of Rs. 50,000/- per hectare of land was added to investment, the production costs went upto Rs. 1.94/- nut.

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

Mahalle and Galgalikar (1987) revealed that the gross cost of establishment per hectare for each of the first six years in the case of Khagzi lime orchard worked out to Rs. 2,280, Rs. 2,178, Rs. 2,155, Rs. 2,692, Rs. 3,413 and Rs. 4,050 respectively and net cost of establishment worked out to Rs. 1,629, Rs. 1,980, Rs. 1,751 Rs. 2,219, Rs. 2,152 and Rs. 3,303 in that order. The total gross cost and net cost of establishment of lime orchard for all the six years worked out to Rs. 16,700 and Rs. 12,736 per hectare respectively.

Randev *et al.* (1987) worked out the establishment cost of almond orchard during 1984-85 as Rs. 12,003 per hectare excluding the value of land and operating costs were ranging from Rs. 5,121 to Rs. 11,024 per year per hectare.

Thiam (1987) found out that the cost of production of one tonne of palm oil in Malaysia ranged from M $ 449 to M $ 575 with an average of M $ 512. The production cost was lowest for the plantation sector and highest for the land development scheme. Similar analysis was carried out for Malaysia, Indonesia, Thailand and Coted Ivorie revealed that the cost of production was lowest for Malaysia (US $ 240/t CPO).

Nallathambi *et al.* (1988) worked out the cost for establishing one hectare of coconut plantation for the initial seven years period excluding the interest on investment to Rs. 23,804 and Rs. 35,254 for rainfed and irrigated conditions. The production costs of coconut in Tamilnadu was estimated at Rs. 1.18 and Rs. 1.10 per nut respectively under the above two conditions.

Sudha and Reddy (1988) found that the cost of cultivation of sweet orange in the first year was Rs. 7,664.52 where as the average annual cost of maintaining a bearing orchard was Rs. 7,446 per hectare; manuring (49 per cent), plant protection (14 per cent) and irrigation (8 per cent) were the major cost items of maintaining a bearing orchard.

Patil and Dalvi (1990) in their study on financial appraisal of coconut plantation considered the first six years of orchard life as establishment period. The maintenance cost started from seventh year onwards. The annual maintenance cost was Rs. 6,513 per hectare and annual amortization cost was Rs. 4,154.

Srinivas (1991) calculated the total cost of establishment of cashewnut orchard in Prakasam district of Andhra Pradesh during the first year at Rs. 3,588.97. About Rs. 2,524.29 was incurred on labour and Rs. 1,057.11 on material inputs. The cost of establishment from second to fifth year was Rs. 1,582.57, Rs. 1,601.24, Rs. 643.72 and Rs. 518.48 respectively. Maintenance cost during bearing period (from sixth year onwards) was Rs. 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 Rs. 1,191.62 per hectare.

Holla and Rajan (1992) stated that the unit cost of palm oil was much lower than that of the other seed oils.

Kumar (1992) in his study reported that the cost of production of oil palm to raise one hectare of plantation upto 4th year was Rs. 30,000/- and further revealed that the cost of maintenance per year was about Rs. 6,500 per hectare.

Okorie and Daniel (1992) identified the costs and returns of the oil palm project in Venue state Nigeria divided the costs into capital and operating costs. Capital costs amounted to ₦ 2.05 million while the operating costs amounted to ₦ 0.284 million.

Reddy *et al.* (1993) while working on annual costs and returns of sweet orange in Prakasam district of Andhra Pradesh found out that expenditure on manures and fertilizers accounted for 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 large orchards than for small orchards.

Hiremath *et al.* (1995) while studying the role of the intercrops in reducing establishment cost of lime orchard worked out cost of establishment of orchard at Rs. 56,429.58 in small, Rs. 49,179.62 in medium and Rs. 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.

Radhika (1995) in her study on economics of oil palm cultivation in Andhra Pradesh concluded that the establishment cost of the crop during the first year was Rs. 14,826 per hectare, of which the cost of

planting material accounted for highest expenditure of Rs. 6,636 (44.76 per cent). The maintenance cost of oil palm orchards ranged from Rs. 5,391 to Rs. 7,727 per hectare in 4th year of which fertilizer accounted for highest expenditure ranging from Rs. 2,346 to Rs. 3,400 per hectare (42 to 49 per cent).

Oil palm development programme in Andhra Pradesh (1995) introduced by NABARD estimated the unit cost of oil palm cultivation for a period of four years at Rs. 38,000 per hectare including the cost of planting material. For this it was proposed to extend the subsidy to the farmers upto Rs. 16,250 per hectare.

Rangachary (1995) in his study on economic analysis of oil palm cultivation in West Godavari district of Andhra Pradesh revealed that the cost of cultivation during pre-bearing period from 1st year to 3rd year was Rs. 34,081.07 per hectare and average cost of cultivation for 4^{th} and 5^{th} year bearing orchard was Rs. 7,009.31 per hectare per year.

Reddy (1995) in his study on cost structure of papaya cultivation in Cuddapah district of Andhra Pradesh worked out that the cost of cultivation of papaya (bearing orchard) ranged from Rs. 31,938.50 on one year old orchards to Rs. 1,21,244.56 on the orchards of three years old. The variable costs accounted for 37.67, 70.90 and 65.83 per cent of the

total costs for a period of one year, two years and three years respectively.

Chinnappa and Umesh (1996) in their work on arecanut production under command area noticed that the establishment cost incurred by arecanut growers was Rs. 1,50,581.98 per acre out of which Rs. 28,691.56 was spent in first year itself. Variable costs accounted for 77.35 per cent while fixed costs 22.65 per cent of the establishment costs.

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

Vandana *et al.* (1996) estimated the total cost of establishment of acid lime during first year at Rs. 9,946.11 per hectare of which labour accounted for 58.33 per cent and material inputs accounted for 41.47 per cent. In second and third years the costs incurred were Rs. 5,710.57 and Rs. 7,369.49 per hectare respectively. The maintenance cost per hectare from fourth to seventh year stood at Rs. 9,089.60, Rs. 12,006.67, Rs. 14,296.38 and Rs. 18,184.64 respectively. From eighth year onwards the

maintenance cost was Rs. 19,797.05 per hectare. The total cost of production of acid lime per hectare was Rs. 38,719.81 of which direct costs contributed 51.93 per cent and indirect costs 48.07 per cent.

A study conducted by Usha Rani (1996) on mango in Chittoor district of Andhra Pradesh indicated that the first year cost of establishing mango orchard amounted to Rs. 12,521. The total cost of establishment from 2nd to 5th year was Rs. 19,578. The maintenance costs increased from Rs. 7,396 in 6th year upto Rs. 25,720 in 40th year.

Rao *et al.* (1997) in their study on profitability of mango cultivation in drought prone areas - A case study of Ananthapur district of Andhra Pradesh worked out the cost of production per hectare of mango garden at Rs. 17,828 out of which direct costs formed 33 per cent and indirect costs accounted for 87 per cent.

Chinnappa and Ramana (1997) in their study on economic analysis of guava production reported that the total cost of establishment of guava orchard amounted to Rs. 14,236.83. About Rs. 4,479.51 was incurred on labour which accounted for 33.57 per cent of total cost. Material cost per acre of guava orchard was Rs. 5,695.81 which accounted for 40 per cent of total cost. The remaining 26.43 per cent was taken by fixed costs.

Pratap (1997) in his study on economic analysis of production and marketing of acidlime in Nellore district of Andhra Pradesh revealed that the commercial cost of cultivation was Rs. 11,77,625.90 and Rs. 11,20,759.11 for small and large farms respectively.

Usha Rani (1997) estimated the total cost of cultivation per hectare of ber orchard at Rs. 12,80,608 during its life span of 30 years.

Gangwar and Singh (1998) in their study on economic evaluation of Nagpur mandarin cultivation in Vidharbha region of Maharastra worked out the total establishment cost of orchard at Rs. 35,452. The amortization cost over 26 years at the rate of 12 per cent was Rs. 4,490. The maintenance cost from sixth year onwards varied from Rs. 12,667 to Rs. 22,403 per hectare.

Anand *et al.* (1998) while comparing the economics of drip and surface irrigation systems in grapes observed that the cost of cultivation per acre of grapes in drip irrigation worked out to be Rs. 19,975 while it was Rs. 21,658 in case of surface irrigation. The cost of production per acre of grapes under drip irrigation was lower by 7.77 per cent (Rs. 1,683) when compared to surface irrigation.

Mahesh *et al.* (1999) in their study on an economic analysis of seedless grape cultivation in Vaigaiveeran - Azahgumuthu district, Tamil Nadu revealed that the establishment cost of sample vineyards upto the age of bearing amounted to Rs. 2,71,661.28 per hectare. Pandal erection formed the major item of expenditure which amounted to Rs. 1,02,719.19 forming 37.81 per cent of the total establishment cost followed by rental value of owned land (15.73 per cent) and labour cost (15.58 per cent). The annual maintenance cost during the bearing period amounted to Rs. 1,33,138.15 per hectare. Manures and fertilizers formed the major item of expenditure with Rs. 42,845.50 accounting for 32.18 per cent followed by expenditure on labour (25.58 per cent), plant protection (19.34 per cent), irrigation (1.55 per cent), hormonal treatment (2.33 per cent) and other costs (18.72 per cent).

Radharani (2000) in her study on an economic analysis of production and marketing of sweet orange in Anantapur district of Andhra Pradesh reported that the commercial costs of cultivation per hectare for the life span of sweet orange orchards stood at Rs. 12,32,193.70.

2.2 STUDIES ON RETURNS

Das (1984) in his study on production costs and returns of coconut plantations in Kerala estimated the net returns to be Rs. 4,200 per

hectare at a farm gate price of Rs. 1.50 per nut. The per hectare returns to family labour and investment per hectare of coconut garden stood at Rs. 5,760 per hectare.

Subramanyam (1986) estimated the gross returns from acid lime and sweet orange at Rs. 11,250.00 and Rs. 911.75 respectively. The returns over maintenance costs were Rs. 10,331.37 and 8,432.17 and returns over maintenance and overhead cost were Rs. 6,617.25 and Rs, 5,102.32 in lime and sweet orange respectively per hectare per year.

Awasthi *et al.* (1987) in their study on economics of guava orchard in Jabalpur district of Madhya Pradesh revealed that the positive net returns started only in the fourth year and they reached upto Rs. 5,694 per hectare in the sixth year which was assumed to continue for next 24 years.

Nighot *et al.* (1987) observed that yield of orange per hectare and per tree was 114.5 thousand fruits and 344 fruits respectively while gross returns per hectare stood at Rs. 28,599.00 and Rs. 8,600 respectively.

Abraham (1988) concluded that the yield of all the oil seed crops except oil palm was below one tonne of oil per hectare while oil palm

was capable of giving 4 to 6 tonnes of oil per hectare on an average providing a gross return of Rs. 40,000 to Rs. 50,000 per hectare and yields were stabilized from 10th year onwards.

Sudha and Reddy (1988) revealed that gross returns showed a steady increase from Rs. 9,206 per hectare in sixth year to Rs. 13,043 in fifteenth year of the sweet orange crop.

Thomas and Nampoothiri (1988) in their study on economics of oil palm cultivation reported that the respective cost of maintaining the plantations in rainfed and irrigated conditions was Rs. 3,600 and Rs. 4,200 per hectare. The gross cost of establishing one hectare of oil palm plantation upto the end of eighth year under rainfed and irrigated conditions was Rs. 37,000 and Rs. 50,000 respectively and respective profits stood at Rs. 14,000 and Rs. 33,500. The net profits were Rs. 31,500 and Rs. 48,700 per hectare per year during stabilized bearing period.

Nallathambi *et al.* (1988) estimated the annual returns from one hectare of rainfed and irrigated coconuts in Tamil Nadu at Rs. 5,197 and Rs. 8,227 respectively.

Daswir (1989) studied the cultivation efficiency and small holders income in the oil palm small holder scheme at PIR-Ophir, Sumatra based on actual production and production costs of fresh fruit bunches (FFB) during 1985-88 (before and after the conversion). The cost price per kg of FFB during the harvesting years i.e one to four (1985-88) was Rp 21.48 ; Rp 13.97 ; Rp 35.54 and Rp 50.53 respectively. The income earned during the first, second, third and fourth harvesting years was 36 per cent, 62 per cent, 80 per cent and 120 per cent of the target set by the Government (US $ 1500) respectively.

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

Hugar *et al.* (1991) in their study on economic feasibility of guava cultivation under scientific management showed that the per hectare gross and net returns ranged between Rs. 2,000 to Rs. 45,000 and Rs. 856 to Rs. 38,439 respectively.

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Srinivas (1991) in his study on economic analysis of cashewnut production, marketing and processing in Prakasam district worked out the gross returns obtained by selling the main and byproducts at Rs. 3,919.13 per hectare.

Kumar (1992) in his study concluded that oil palm cultivation will be main study in the Bhadra command area in years to came as the introduction of this crop gives a very healthy diversification in the cropping pattern. Although at current prices the arecanuts and coconuts were very remunerative, the oil palm was more remunerative than the traditional crops of this region such as paddy, groundnut, sugarcane etc.

Thomas *et al.* (1993) conducted a study on short term credit requirements for coconut cultivation in Trichur district and observed that the average yield of coconut was 72 nuts per palm per year giving a return of Rs. 242.95.

Wani *et al.* (1994) in their study on economic viability of apple orchards in Kashmir worked out the gross returns which ranged from Rs. 1,300.00 per hectare in the first year of establishment to Rs. 92,901 per hectare in the 32nd year. However the significant but gradual increase in the returns from 9th year upto 31st year could be attributed to the fact that production increased with the increase in age then

stabilised between 24-31 years and decreased there after. The average net returns over respective total cost per year was Rs. 28,234.01.

Rao (1995) in his study on economic analysis of cashewnut production estimated gross and net returns as Rs. 20,953.21 and Rs.7,059.23 per hectare.

Motial (1996) worked out the net returns from oil palm cultivation during its life span of 25 to 30 years which ranged from Rs. 40,000 to Rs. 90,000 per hectare depending upon the management of crop.

Rao *et al.* (1997) in their study on profitability of mango cultivation in drought prone areas - A case study of Ananthapur district of Andhra Pradesh worked out the gross returns from mango at Rs. 22,083 per hectare. The net returns obtained by deducting the direct cost from the gross returns worked out to Rs. 16,194 per hectare.

Pratap (1997) estimated gross income from acid lime which was higher at Rs. 18,39,878.52 on small farms compared to Rs. 17,63,328.08 on large farms for entire economic life period of acid lime orchard. The net incomes for the 30 years was Rs. 6,62,252.62 and Rs. 6,42,568.97 on small and large farms respectively.

Usha Rani (1997) worked out the gross and net incomes obtained per hectare of ber orchard during its economic life period of 30 years at, Rs. 33,21,352 and Rs. 20,11,563 respectively.

Sandhyakiran (1997) found out that the gross and net incomes per hectare of guava orchards were Rs. 29,51,838.00 and Rs. 15,12, 732 respectively.

Gangwar and Singh(1998) in their study on economic evaluation of Nagpur mandarin cultivation in Vidharbha region of Maharastra worked out the average gross returns per hectare to Rs. 30,864.

Korikanthimath *et al.* (1998) carried out a study for four years (1990-91 to 1993-94) on mixed cropping of cardamom, pepper and coorg mandarin with robusta coffee revealed that net returns of Rs. 1,05,213 per hectare were realised in mixed cropping which was 3.69 times more than monocrop.

Remold's (1999) study on cost benefit analysis of coconut cultivation under irrigated conditions revealed that an annual income of Rs. 78,750/- was obtained from one hectare of coconut orchard.

Remold (2000) in his study on cost-benefit analysis of rainfed coconut cultivation revealed that the annual income derived was Rs. 47,250.

2.3 STUDIES ON ECONOMIC VIABILITY

Gupta and George (1974) analysed the economic viability of santra gardens by using discounted techniques like NPV, IRR and BCR. The IRR value ranged from 29.3 to 45.9 per cent depending upon the size of the groove. The NPV, BCR even at a high discount rate of 12 per cent varied from Rs. 4,260 to Rs. 7,910 per acre and 1.85 to 2.64 respectively.

Raghupathy *et al.* (1979) evaluated the economic feasibility of coconut plantation in three different projects. A discount rate of 9 per cent was used to discount the costs and returns at the lending rate of co-operative banks for long term loans. The economic life of coconut was taken as 70 years. Among these three projects NPV (Rs. 2,659) and BCR (5.95) were maximum in project III. But IRR (13.55 per cent) was the highest in project II.

Elasamma and Mukundan (1984) found that the BCR, IRR and NPW were 2.04, 24.20 per cent and Rs. 25.597 respectively for rubber plantations.

Rao (1984) found out that a casuarina plantation raised for five years gave annuity value of Rs. 1,193.04 at 24 per cent discount rate. The internal rate of return worked out to 61.55 per cent. Eight years plantations gave an annuity value of Rs. 1,641.40 and Rs. 717.89 at 11 per cent and 24 per cent respectively and the calculated internal rate of return stood at 41.13 per cent.

Nagaraj *et al.* (1987) examined the profitability and economic feasibility of investment in the coconut enterprise. The net present worth for the entire project was found to be Rs. 77,167. The discounted benefit-cost ratio was 1.69 at 12 per cent and the internal rate of return was 21.40 per cent.

Randev *et al.* (1987) evaluated the profitability of almond cultivation in Kinnaur district of Himachal Pradesh by assuming 30 years of life span with 10 years of commercial bearing. The costs and returns were discounted at 12, 18, 24 and 30 per cent discount rates and worked out the net present worth, gross benefit-cost ratio and internal rate of return as Rs. 68,593.44, 2.67 and 29.01 per cent respectively at 18 per cent discount rate.

Srinivasan (1987) observed that the benefit-cost ratio was more than unity and NPV was positive and IRR was about 50 per cent for grape orchards.

Sudha and Reddy (1987) revealed that coconut palm cultivation in Chittoor district of Andhra Pradesh had an annuity value, internal rate of return and benefit-cost ratio as Rs. 4,987, 22 per cent and 2.14 respectively.

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

Patil *et al.* (1989) calculated the BCR and IRR at 2.27 and 22.06 per cent respectively in their study on economic feasibility of coconut plantations.

Sudha and Reddy's (1990) study on economic feasibility of cashew nut revealed that the BCR, NPV and IRR at 12 per cent discount rate were 1.31, Rs. 4,973.38 and 15 per cent respectively.

Vijuipe and Varghese (1990) in their study on economics of nutmeg cultivation in Kerala revealed that the net present worth, benefit-cost ratio and internal rate of return were Rs. 1,220,18, 1.89 (at 14 per cent discount rate) and 24.62 per cent respectively.

Goswami (1990) in his study on investment analysis of plum and mandarin plantations worked out the NPW for plum and mandarin plantations at Rs. 6,884.83 and Rs. 10,216.76 respectively. The respective benefit-cost ratios of plum and mandarins were 1.38 and 1.52.

Hugar *et al.* (1991) worked out the NPW, BCR and IRR to know the economic feasibility of guava cultivation. The net present worth during the life period of the orchard worked out to be Rs. 7,38,042 per hectare. The BCR, IRR were found to be 3.88 and 57.82 per cent. Since BC ratio was more than unit, and IRR was higher than the prevailing bank rate (14 per cent) the economic potentiality of scientific cultivation of guava appeared to be strongly viable.

Okorie and Daniel (1992) analysed the costs and returns of the oil palm project in Venue state; Nigeria from 1974-85. The aggregate streams of costs and benefits gave a benefit-cost ratio of 0.195 using a 10 per cent discount rate at prevailing market prices. But using the subsidized prices at which the oil palm products were sold and the same 10 per cent discount rate, a benefit-cost ratio of 0.012 was obtained. With the incorporation of inflationary factor into the discount rate much lower B.C ratio was obtained.

Naik *et al.* (1992) in their study on economic evaluation of investment in cashew orchard revealed that the calculated NPV and BC ratios were Rs. 86,424, Rs. 72,332 and 2.37, 1.89 at 11 and 14 per cent discount rates respectively.

Jaganathan (1992) in his study on an economic analysis of coconut farming in Anaimalai block of Coimbatore district of Tamil Nadu revealed that the benefit-cost-ratio at 12 per cent discount rate was 1.42 without intercropping and 2.18 with intercropping. Net present value was found to be Rs. 23,750 in case of gardens without intercropping and the same was Rs. 66,717 in case of garden with intercropping. The internal rate of return was about 25.68 per cent.

Singh and Khatkar (1994) while examining the economic feasibility of grape orchard used a discount rate of 13 per cent and calculated NPV and benefit-cost ratio. The NPV came to Rs. 61734.53 per hectare and BC ratio equal to 1.18. The IRR worked out was 23 per cent.

Srinivas *et al.* (1994) while analysing economic feasibility of cashewnut production in Prakasam district of Andhra Pradesh worked out the net present worth, benefit-cost ratio and internal rate of return at Rs. 5,558.20, 1.20:1 and 18.97 per cent respectively. These indicated that the investment on cashew orchards was a profitable proposition.

Rangachary (1995) worked out the Net present value, Benefit-cost ratio and Internal rate of return as Rs. -5474.57, 0.85:1 and -2.42 per cent which indicated that the investment made on oil palm orchard upto 5th year was not profitable.

Radha (1996) in her study on economics of viticulture worked out the feasibility of investment in grape cultivation. The calculated BC ratio, NPV and IRR were 1.44, Rs. 80,876.98 and 42.34 per cent respectively at 12 per cent discount rate.

Vandana *et al.* (1996) estimated the IRR for acid lime cultivation in Guntur district at 39.41 per cent. The net present worth was positive (Rs. 43,607) even at 20 per cent discount rate and benefit-cost ratio was 1.58 at the same discount rate and hence concluded that acid lime cultivation was a profitable proposition.

Padmanabhan and Ramaswamy (1997) showed that the NPV was Rs. 42,037.91, BC ratio 6.78 and IRR 151.49 per cent for monocrop of irrigated casuarina and the corresponding figures for intercropped rainfed casuarina were Rs. 44,178.93, 5.27 and 153.15 per cent respectively.

Sandhya Kiran (1997) while studying the worthiness of investment in acid lime orchards calculated NPW and benefit-cost ratio at a discount rate of 24 per cent as Rs. 77,103.60 and 1.55 respectively. IRR was found to be 58.18 per cent.

Gangwar and Singh (1998) examined the economic viability of Nagpur mandarins by employing project evaluation techniques. The net present value at 12 per cent discount rate varied from Rs. 40,718 to Rs. 45,654 per hectare depending upon the size of mandarin orchard. The benefit-cost ratio for overall group was 1.425. The internal rate of return was lowest (25.78) for larger orchards (above 2 ha).

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

Remold (1999) in his study on cost benefit analysis of coconut cultivation under irrigation conditions estimated the annuity value and cost-benefit ratio as Rs. 33,914 and 1:1.5 respectively at 13 per cent discount rate.

Remold (2000) in his study on cost benefit analysis of rainfed coconut cultivation revealed that the annuity value (at 13 per cent) and cost benefit ratio of rainfed coconut were about Rs. 28,469 and 1:1.02 respectively.

Radharani (2000) observed that the net present value was as high as Rs. 2,17,943.62 at 12 per cent and Rs. 52,109.67 at 24 per cent. The benefit-cost ratio was 1.65 even at higher discount rate of 24 per cent. The IRR was calculated at 42.28 per cent. All these measures indicated the economic viability of sweet orange cultivation.

2.4 STUDIES ON PROCESSING

Chandrachud (1966) in his study on co-operativization of groundnut processing concluded that each oil mill expected to run for 300 days is rated to process about 1,200 tonnes of groundnut valued at approximately Rs. 18 lakhs to give about 360 tonnes oil and 40 tonnes oil cake valued at Rs. 16 lakhs and Rs. 3 lakhs respectively.

Shukla and Pandey (1966) in their study on location and role of mustard and rape seed processing industry in Hissar concluded that the margin of profit on one quintal of mustard and rape seed in large, medium and small sized mill was Rs. 7.02, Rs. 4.86 and Rs. 3.43 respectively.

Singh and Sidhu (1974) in their study on economics of groundnut processing industry in Punjab worked out the per quintal fixed costs in large, medium and small mills at Re 0.50, Rs. 1.14 and Re 0.58 respectively. The variable costs on per quintal basis for decortication and crushing were found to be Rs. 118.72, Rs. 119.74 and Rs. 118.27 in large, medium and small mills respectively. The respective per quintal total cost in the above sized mills were Rs. 119.23, Rs. 120.87 and Rs. 118.85. The net profit margin for processing one quintal of ground nut pods in large, medium and small mills was found to be Rs. 31.16, Rs. 24.85 and Rs. 23.33 respectively. In large sized mills the fixed costs were saddled on the greater number of units produced and the resultant unit cost of production of oil was found to be low as compared to the smaller unit.

Williams and Rathod (1974) in their study on economics of soybean processing revealed that the estimated margin expeller plants have to cover product marketing costs and the profits ranged from approximately Rs. 103 to Rs. 143 per tonne below those from solvent extraction units of 50 to 250 tonnes daily capacity.

Rao *et al.* (1982) observed that oil palm nut has been processed in conventional oil mill equipments. It is deshelled and the fractions with 80 per cent kernel and 20 per cent shell is expelled giving 32 per cent oil. Palm kernel oil is refined and bleached to light colour.

Keddie *et al.* (1983) considered three main stages of processing as the pre-processing stages (drying, crushing scorching, the oil extraction stage and the post treatment stages viz. filtering, cake breaking, packing and bagging). They suggested various policy measures for the promotion of the right mix of the oil extraction techniques that will minimize production costs and improve the quality of the oil produced.

Rajeswari (1986) indicated that the estimated expenditure on processing of raw cashewnut was Rs. 2 46/- per 80 kg rawnuts and she also found out that the packing and shipping charges incurred to the extent of Rs. 5,327.

Reddy *et al.* (1986) reported that the approximate expenditure for processing of one tonne of raw cashew nuts was Rs. 12,350. Expenditure on processing included the costs incurred on drying / roasting, shelling, peeling, grading and packing at different stages of processing of raw cashewnuts.

Acharya and Agarwal (1987) observed that the cost of processing per quintal of ground nut shell / sesame ranged between Rs. 20.50 with a 6 bolt expeller.

Arora *et al.* (1988) observed that the co-operative sector plant was found to be most inefficient having a processing cost of Rs. 90.16 per quintal against a private sector plant where the processing cost was Rs. 54.20 only for soybean processing in Uttar Pradesh. Further they noted that the processing cost of soybean could be reduced by increasing the use of available installed capacity, optimum use of input (Hexane), power and fuel.

Jagadiswar (1989) observed that the processing costs per quintal of groundnut oil production was highest in case of category-IV (Rs. 2525.09) compared to all other categories. Because it has incurred more repair charges (6.14 per cent of total processing costs) and more depreciation charges (1.59 per cent) per quintal of oil produced in category IV oil mills. In all categories of oil mills, the variable costs constituted maximum proportion of total costs, which ranged from nearly 97 per cent to 99 per cent of total costs. The reason for this might be due to maximum raw material costs in all categories of oil mills (nearly 77.57 per cent.)

Hyman (1990) stated that the traditional technology of processing palm fruits was laborious and led to low yield of oil.

Vijayarajan (1990) examined the role played by the agrobased and processing industries in agricultural marketing and marketing financing. Two cases were represented, a co-operative sugar mill and a co-operative oil palm based unit representing a large scale sector and a small scale cottage industry sector respectively.

Holla and Rajan (1992) indicated that among the perennial oil bearing crops, oil palm is highest oil yielding plant producing 3-5 tonnes of oil per hectare. It thus holds a crucial place in the edible oil economy of the country.

Davli *et al.* (1992) worked out the cost per tin of cashew nut oil including cost of processing, marketing and returns was Rs. 862.82, Rs. 841.23 and Rs. 953.33 in case of group I, II and III mills respectively. While overall cost per tin was Rs. 914.98. The net returns per tin worked out to Rs. 163.72 in group I, Rs. 221.94 in group II and Rs. 161.27 in group III. The overall net returns per tin were Rs. 174.52.

Gopalakrishnan *et al.* (1993) explained that raw palm oil is unique in certain aspects especially the high carotene content, colour fixation, and solid fat setting etc. which are not found in the conventional oils processed in India. Since these problems affects adversely the processing of palm oil on an industrial scale these need to be probed into. If

processing was not carefully done at each stage of palm oil extraction from the harvesting operation onwards, the raw oil will have significantly high level of free fatty acid content which is known to cause problems while refining. Hence, the oil quality should be well maintained during the extraction process it self.

Hedgire (1993) while studying the economics of processing of groundnut revealed that the cost of processing worked out to about Rs. 68 per quintal. The purchase tax and sales tax at 4 per cent were reported as the major items of cost. The net profit per quintal in the processing of groundnut amounted to Rs. 52.

Rajmane (1993) in his study on economics of production, marketing and processing of sunflower in Marathwada region of Maharashtra noted that the per quintal cost of processing was about Rs. 58. The purchase tax and sales tax at 4 per cent were the major items of processing.

Arif and Nasir (1997) analysed the medium term oil palm fresh fruit bunches processing cost using data collected from three mills in the states of Perak, Pahand and Johore of Malaysia for the period 1992-1995. They concluded that despite a 19 per cent increase in total operating costs, the unit cost of FFB processing remained relatively stable at M $ 21.30 in 1992 to M $ 21.20 in 1995. This resulted from an

increase in mill capacity utilization and the spreading effects of fixed costs.

Rao and Krishnaiah (1999) in their study on economics of cashewnut processing in Srikakulam district of Andhra Pradesh divided the processing costs into labour and material costs. The results revealed that an amount of Rs. 366.12 was incurred by processor towards the processing cost per bag of 80 kg of rawnuts. It was found that material costs accounted for 65.35 per cent and labour cost 34.10 per cent of the total processing cost. Among labour costs shelling was the most important operation with Rs. 60.50 (16.52 per cent). Packing charges accounted for 65.67 per cent of the total processing cost. The cost of rawnuts, taxes and costs incurred on processing stood at Rs. 366.12 leaving a considerable margin of about 21 per cent to the processors.

2.5 STUDIES ON PROBLEMS OF PRODUCTION AND PROCESSING

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

Sharma and Thakur's (1985) study on prospects and problems of fruit industry in Himachal Pradesh pointed out major production constraints in fruit production as difficulty in getting planting material, diseases and pests, shortage of inputs, lack of technical knowledge and pollination problems.

Srivastava (1989) in his study on agro-processing industries-Potential constraints, identified the major problems in agro-processing viz. the inadequacy and non-suitability of raw materials, short period of raw material availability and excessive costs of raw material. The constraints on processing and marketing related to technology, market development and financial aspects.

Srinivas (1989) revealed the problems in production and marketing of coconut as (1) farmers were not following recommended package of practices (2) No facilities of providing information regarding the high yielding varieties. That is why farmers are mainly growing local varieties (3) Population per hectare is not being maintained in accordance with the recommended number of trees in the garden per hectare.

Rao and Rajasekhar (1992) identified major constraints in oil palm cultivation like non-availability of planting material, narrow genetic base of higenous tenerae problems in acquiring planting material, pests and diseases, organisational problems etc.

Rangachary (1995) identified some problems regarding production and processing of oil palm viz. technological problems, organisational problems, price problems and processing problems. For processing, the product should reach with in 24 hours to the factory after harvesting, otherwise the oil recovery is less than the expected level (i.e 15%- 18%).

Rao *et al.* (1997) identified the major constraints for decline in citrus production in Southern Telangana zone as low fertility status of the soil, use of unknown root stocks, occurance of insect pests and diseases, erratic rainfall and unawareness of the latest production technology.

Ramandev *et al.* (1999) identified the problems of cashew processing industry as procurement and availability of labour, taxation, availability of land, government policies, lack of infrastructural facilities etc.

Dixit and Rao (1999) in their study on problems in cashew cultivation-Farmers perspective, revealed that the productivity of cashew was reduced because of non-adoption of improved cultivation practices, lack of interaction with extension personnel (or) researchers, untimely rains and virtually no winter.

The literature reviewed above on different aspects of oil palm plantations and different related crops helped to study different aspects of oil palm cultivation in detail and thus gave a better understanding to conduct the research work in a smooth way. The studies conducted particularly on oil palm and other related crops have been very useful as this work is based largely on such studies, but unfortunately not much of literature could be obtained on the cost of cultivation, economic viability and processing of oil palm. Hence the present study on oil palm cultivation was conducted, which find an important phase for the researchers in future.

METHODOLOGY

CHAPTER - III

METHODOLOGY

Perfect understanding of the design of the study is a sin-quo-non for any scientific enquiry. So an attempt has been made in this chapter to describe the methodology adopted, sampling procedure, nature of data collection and analytical tools employed in achieving the objectives of the study. This chapter is presented under the following heads.

3.1 SAMPLING PROCEDURE

3.2 COLLECTION OF DATA

3.3 METHODS OF COMPUTATION

3.4 TOOLS OF ANALYSIS

3.1 SAMPLING PROCEDURE :

Multistage stratified sampling technique was adopted to select the ultimate sampling unit

3.1.1 Selection of District :

Nellore district was purposively chosen for the study as it has considerable area (2,766 ha) under oil palm and ranks fourth in the cultivation of oil palm in Andhra Pradesh. According to survey conducted by Dr. Rethinam Committee more than 3,500 hectares of area is suitable for oil palm cultivation in this district since this district has immense irrigation potential.

3.1.2 Selection of Mandals :

All the mandals in Nellore district growing oil palm orchards were listed out and arranged in descending order of their area under oil palm cultivation and the top 3 mandals were selected purposively. Selected mandals along with their area under oil palm are presented in Table 3.1

Table 3.1 Area under oil palm cultivation in selected mandals of Nellore district (1998-99)

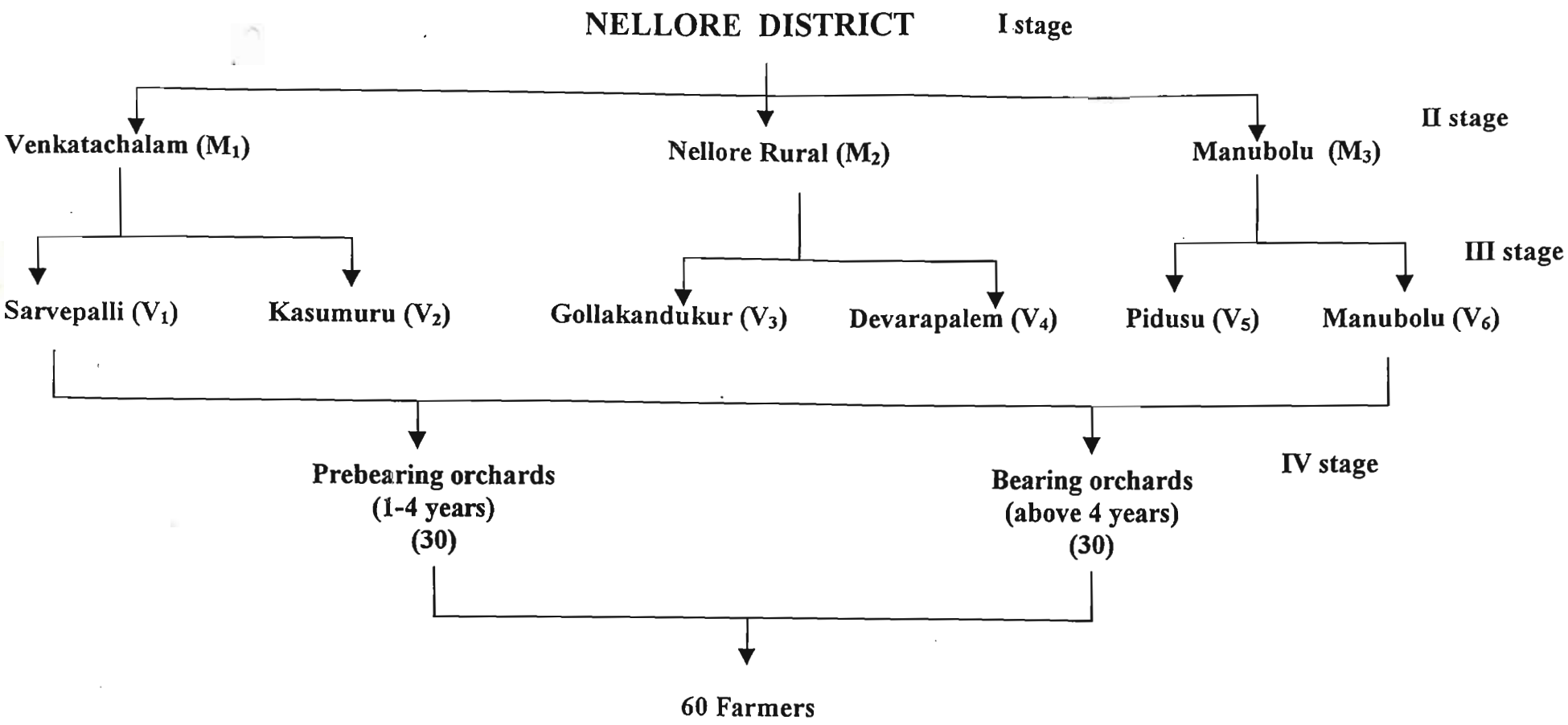
Mandal	Area in hectares
Manubolu	328.21
Venkatachalam	247.41
Nellore Rural	128.87

Source : Mandal revenue records

3.1.3 Selection of villages

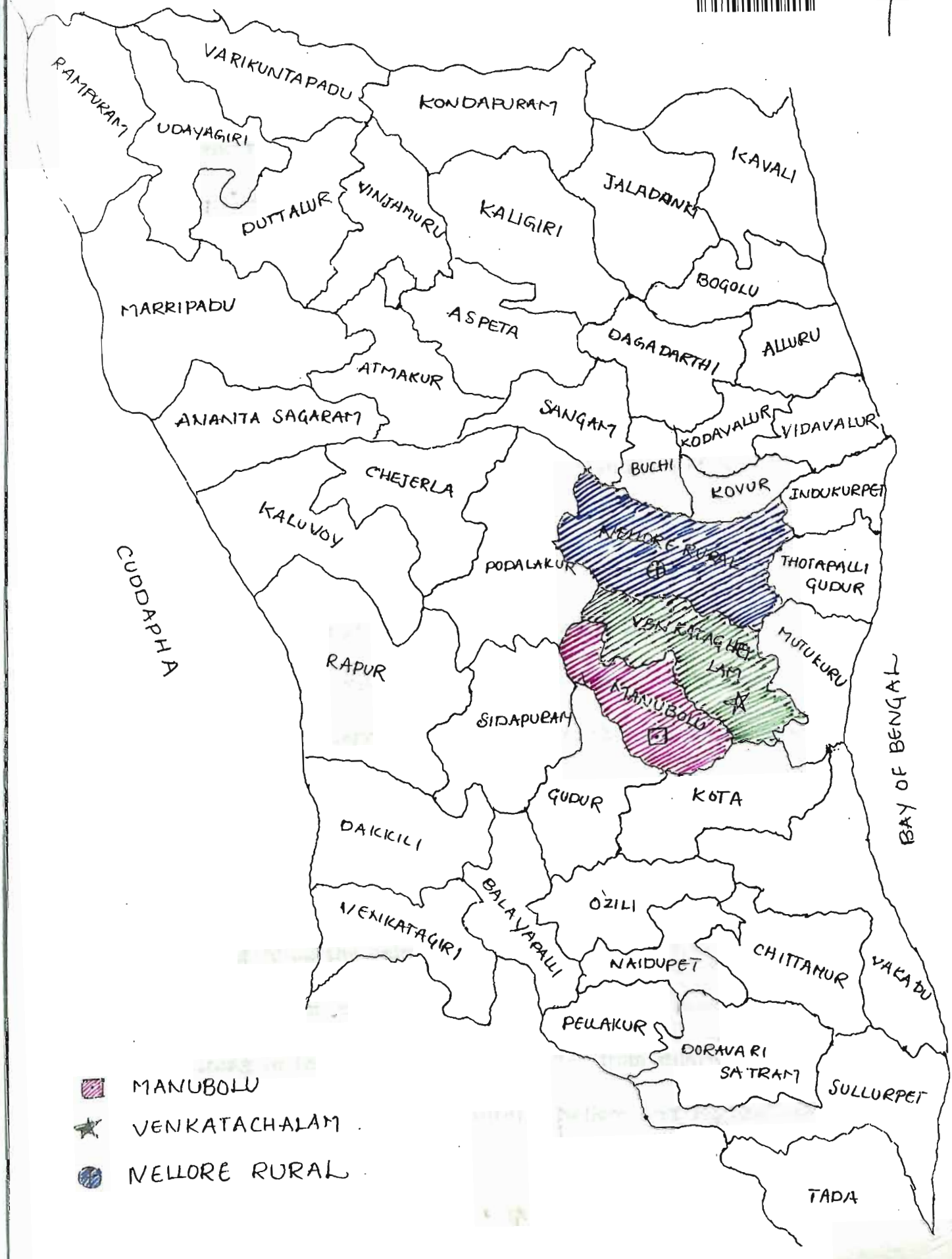
Two villages from each selected mandal were chosen purposively using the above said procedure making total number of selected villages to six. The selected villages included Pidusu and Manubolu of Manubolu mandal, Sarvapalle and Kasumuru of Venkatchalam mandal and Golamkandukur and Devarapalem of Nellore rural mandal. (Fig. 3.1)

Fig. 3.1 Chart showing sampling technique



3.2 : NELLORE DISTRICT MAP

N



3.1.4 Selection of Respondents :

All the oil palm growers in the selected villages were listed out and divided into two groups namely prebearing orchards upto age of 4 years and bearing orchards with the age above 4 years. From the list of oil palm growers, 30 oil palm growers from each group were randomly selected and thus making the total sample size to 60 orchardists.

3.1.5 Selection of processing unit :

The information pertaining to oil palm processing was collected from the lone processing unit located at Manubolu of Nellore district.

3.2 COLLECTION OF DATA :

Survey method was employed to collect the data from the oil palm growers. The data collected for the study related to the agricultural year 1998-99. The primary data pertaining to the production aspects of oil palm were collected directly from the farmers with the help of a specially designed schedule by personal interview and presented at current prices (1998-99) to estimate costs and returns.

Regarding the palm oil processing the information was collected from the palm oil processing unit located at Manubolu. Secondary data pertaining to the oil palm were collected from district planning office Nellore, Department of Horticulture, Nellore and mandal and village records.

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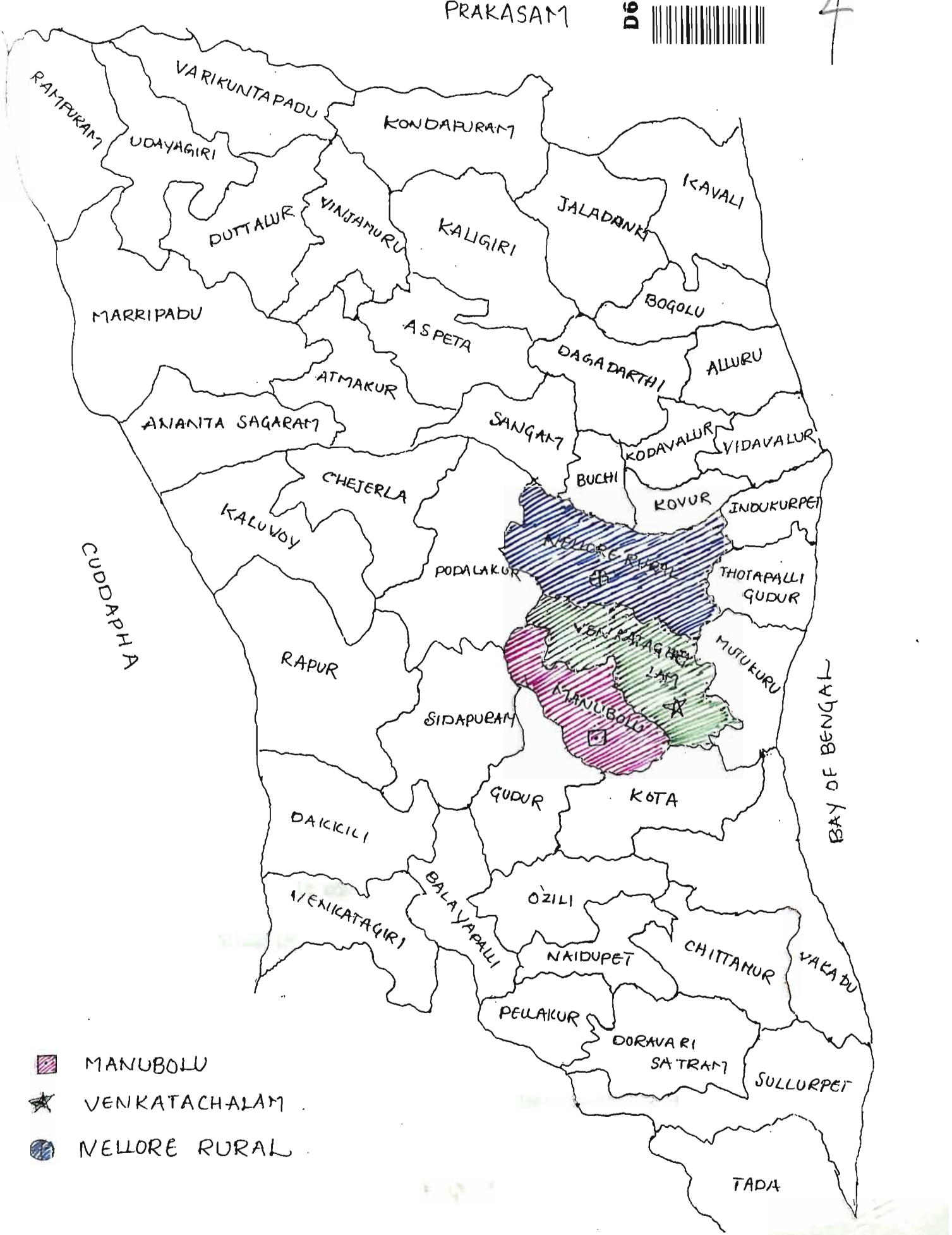
N



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The objectives and importance of the study were explained to the farmers and they were convinced to provide correct information. The details of land holding, cropping pattern, yield obtained, costs incurred for cultivation, irrigation charges, plant protection measures taken, the assistance from the government in the form of subsidies and other related aspects were collected from the selected orchardists. An opinion survey was also carried out to find out constraints in production and processing of oil palm in the study area.

3.2.1 Cost structure of oil palm :

Oil palm is perennial crop with an economic life span of 25-30 years and starts yielding economic benefits from 5^{th} year onwards. Hence the cost incurred can be classified into two categories viz., establishment cost and maintenance cost.

Establishment cost :

The establishment costs included all the expenditure incurred during pre-bearing period (1-4 years) on items like land preparation, cleaning and levelling, digging of pits, cost of plant material, manures, fertilizers, plant protection chemicals, costs incurred on different operations and cost of miscellaneous items like fencing and irrigation.

Maintenance Costs :

All recurring costs required for maintaining the orchard during bearing period such as expenditure on manures, fertilizers, plant protection chemicals and their application charges and expenditure on leaf pruning, intercultivation and watch and ward were considered as maintenance costs. Besides this, land revenue was also considered for working out the cost of maintenance of the oil palm orchard.

3.3 METHODS OF COMPUTATION :

The computational procedure of cost of cultivation of oil palm is explained under following subheadings.

3.3.1 Production aspects :

Production aspects of oil palm included cost of cultivation of oil palm and the returns from the same.

3.3.1.1 Cost structure on oil palm orchards

The total costs were divided into variable costs and fixed costs.

3.3.1.1.1 Variable costs :

Variables costs included cost of human labour, bullock labour, machine labour, plant material, manure, fertilizer, electricity charges and interest on working capital.

Human labour :

The human labour consists of the labour contributed by men, women and children of the farm operator or hired labour. But in oil palm cultivation, employment of child labour was totally absent in the study area. The women labour units were converted into men labour units using the conversion ratio of 2:3 of men to women. Casual hired labour was evaluated at the prevailing wage rates for different operations in the study area.

In the case of permanent labour payment made in kind and other perquisites were evaluated at prevailing market rates and payments made in cash were added to arrive at wages paid and then average wage rate was calculated.

Bullock labour :

The prevailing wage rates in study area per day of 8 hours of work on farm for both hired and owned bullock labour was considered and charged accordingly.

Machine labour:

In the study area, the prevailing rates for various tractor operations were considered based on the acerage tilled. The same rate was considered for both owned and hired tractors.

Plant material :

The selected oil palm orchardists purchased 15-25 months old oil palm seedlings from different nurseries maintained in Nellore district. The cost of seedlings was computed at the prevailing market rates in the study area.

Manures :

Manures included FYM both purchased and produced on farm. The purchased farm yard manure was charged at the prevailing rates. Farm produced manure was evaluated at the local rates as reported by the sample cultivators.

Fertilizers :

The fertilizers used were evaluated at the prevailing market prices plus transportation cost if any.

Plant protection chemical :

Their use in oil palm cultivation was found to be negligible and they were evaluated at the price paid plus transportation charges if any.

Electricity Charges :

In the study area, electricity charges are paid based on slab rate system according to horse power of motor. The electricity charges were apportioned as per the area under oil palm.

Interest on working capital :

The interest on working capital was calculated at the rate of 12 per cent per annum.

3.3.1.1.2 Fixed costs :

Fixed costs included land revenue, rental value of owned land, deprecation, interest on fixed capital and annual share of establishment cost

Land revenue :

The actual amount paid by the farmer towards land revenue was considered.

Rental value of owned land :

As leasing of land for oil palm orchards was absent in the study area, one fourth of the gross returns received in each year of oil palm cultivation was considered as the rental value of owned land.

Depreciation :

The depreciation was worked out for the working assets using straight line method.

Interest on fixed capital :

It was calculated at the rate of 10 percent per annum excluding the land value.

Annual share of establishment cost :

The cost of establishment during the first year(non-recurring expenditure) of oil palm orchard excluding the net income from intercrops was spread over the rest of 24 years of the orchard to get the annual share of establishment cost.

3.3.1.2 Returns from oil palm orchards :

Gross income :

The total income received by the oil palm orchardists from the sale of fresh fruit bunches every year during bearing period was considered as gross income in each year.

Net income :

It is the surplus income over the gross costs.

3.3.2. Processing aspects :

These included costs and returns of oil palm processing.

3.3.2.1. Processing costs of oil palm :

The total cost of processing was divided into variable costs and fixed costs.

3.3.2.1.1. Variable costs :

This was obtained by adding cost of raw material, incidental charges, wages for casual labour, power charges, lubricant charges, fuel charges, miscellaneous charges and interest on working capital.

Raw material purchase cost :

It is the cost of purchasing oil palm fresh fruit bunches from the orchardists.

Transportation and incidental charges :

The purchased FFB were transported to oil mills with in 24 hours after harvesting mostly on contract basis which ranged between Rs.20 to 27 per tonne.

Incidental charges included postage charges, telephone charges and cost of stationary etc.

Wages for casual labour :

Casual hired labour was evaluated at the prevailing wage rates for different operations pertaining to oil palm processing.

Interest on working capital :

This was calculated for cost of raw material, incidental charges, wages for casual labour, power charges, lubricant charges, fuel charges, at 12 per cent rate of interest.

3.3.2.1.2 Fixed costs :

Fixed costs inoil palm processing included depreciation on building and machinery, opportunity cost of land, repairs and maintenance, insurance charges, taxes, salaries for permanent staff and interest on fixed capital.

Interest on fixed capital :

This was calculated for building and machinery at 10 per cent rate of interest.

3.3.2.2. Returns from oil palm processing :

Gross returns :

Gross returns are total sales proceeds of one tonne of oil and resultant kernels by the oil mill.

Net returns :

Net returns calculated by subtracting total processing costs from gross returns.

3.4 TOOLS OF ANALYSIS :

The data collected were subjected to conventional tabular analysis to work out costs and returns of oil palm production and processing. Discounted cash flow techniques were used to analyse the capital productivity on oil palm orchards.

3.4.1 Capital productivity of oil palm orchards :

The measurement of capital production in agriculture assumes importance as it facilitates the most efficient use of resources. But in the case of perennial crops like oil palm, for the capital invested now, the benefits will be realised as a stream in future. The investment made in oil palm plantation is as follows.

i. There has been continuous investment under establishment cost for the first 4 years without economic returns.

ii. Maintenance expenditure is incurred from 5^{th} year onwards.

Discounted techniques :

The discounted cash flow method of evaluating long term projects is a process of finding the present worth of an 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 facilitates comparison between alternative investment choices, if any.

Actual cash inflows and cash outflows are considered in using discounted cash flow techniques for evaluating the capital investment on oil palm orchards. The following discounted cash flow measures were used in the analysis viz. Net present worth, Benefit-cost ratio and Internal rate of return.

Net Present Worth (NPW) :

It is some times referred to as net present value. It is the present worth of the incremental net benefits or incremental cash flow stream. The selection criterion of the project depends on the positive value of the net present worth when discounted at the opportunity cost of the capital.

Net present worth of the project (NPW) is estimated using the following formula.

$$\text{Net present worth} = \sum_{j=1}^{n} \frac{B_j - C_j}{(1 + i)^j}$$

Where Bj = Benefits in j^{th} year

C_j = Costs in j^{th} year

i = Discount rate

n = Number of years

Benefit-cost Ratio (BCR) :

This ratio compares the present worth of costs with present worth of benefits. The common procedure of selecting the project is to chose the projects having the B.C. ratio of more than one, discounted at opportunity cost of capital. This ratio was arrived by using the following formula.

$$\text{Benefit cost ratio} = \frac{\sum_{j=1}^{n} B_j / (1+i)^j}{\sum_{j=1}^{n} C_j / (1+i)^j}$$

Where B_j = Benefits in rupees in j^{th} year

C_j = Costs in rupees in j^{th} year

i = Discount rate

n = Number of years

Internal Rate of Return (IRR) :

It represents the average earning capacity of an investment over the economic life period of the project. It is that discount rate which just makes the net present worth of cash flow equal to zero. In other words, the benefit cost ratio calculated at IRR is unity. Mathematically it can be represented as

$$\text{NPW} = \sum_{j=1}^{n} \frac{B_j - C_j}{(1+i)^j} = 0$$

Where B_j = Benefits in rupees in j^{th} year

C_j = Costs in rupees in j^{th} year

i = Discount rate

n = Number of years

IRR is the maximum interest that a projet could pay for the resources used if the project is to recover its investment and operating costs and still break even. The IRR is arrived through interpolation technique by using different discount rates so as to see that the net present worth is equal to zero. Therefore, the project costs and benefits are discounted at a certain rate to find out the present worth of the project. Again by selecting a higher discount rate, the costs and returns are discounted throughout the project period to get a negative net present worth. The higher value of IRR indicates the first, while lowest value being the last choice of preference. However, the IRR should be more than the discount rate being considered for economic feasibility and financial soundness.

Internal Rate of Return =

Lower discount rate + Difference between higher and lower discount rates $\left(\frac{\text{Net present worth at lower discount rate}}{\text{Absolute difference between present worths at two discount rates}} \right)$

When the calculated IRR is greater than the market rate of interest, then the investment is considered viable.

Sensitivity Analysis :

Sensitivity analysis involves changing one (or) more values in net present worth equation and recalculating the NPV. This analysis provides better insight into the profitability of investment. In the present investigation, the net present value and benefit-cost ratio were calculated at 12, 14, 16, 18, 20, 22 and 24 per cent discount rates covering lending rates of both the institutional and non-institutional financial agencies.

RESULTS AND DISCUSSION

CHAPTER - IV

RESULTS AND DISCUSSION

The present study embodies the results of a field investigation concerning the economic analysis of production and processing of oil palm in Nellore district. The important findings of the study are presented along with relevant discussion. For easy understanding and convenience, this chapter is divided into the following subheads.

4.1 SOCIO ECONOMIC PROFILE OF THE SELECTED RESPONDENTS

4.2 HUMAN LABOUR AND MATERIAL INPUT UTILISATION ON OIL PALM ORCHARDS

4.3 COST STRUCTURE OF OIL PALM ORCHARDS

4.4 RETURNS FROM OIL PALM ORCHARDS

4.5 ECONOMIC VIABILITY OF OIL PALM ORCHARDS

4.6 PROCESSING ASPECTS OF OIL PALM

4.7 PROBLEMS OF OIL PALM PRODUCTION AND PROCESSING

4.1 SOCIO ECONOMIC PROFILE OF THE SELECTED RESPONDENTS

This provides a comprehensive understanding of the families, availability of farm labour, educational status, size of holding, pattern of assets of selected respondents.

4.1.1 Farm Family Composition

The structure of the family in respect of male, female, children and farm family workers is presented in Table 4.1. It is observed that the average size of family was 7.23 comprising 2.86 males (39.56 per cent), 2.25 females (31.12 per cent) and 2.12 children (29.32 per cent). This is high when compared to all India average of around 5 members. This might be due to prevalence of some joint families numbering about 7 to 8 among sample farmers.

It is also observed from the table that the number of farm workers per family was 1.96 which accounted for 27.11 per cent of total family members. The number of male and female workers constituted 15.77 per cent and 11.34 per cent respectively. Children were not involved in agricultural activities. The participation of family members in agriculture was less because majority of the oil palm orchardists belonged to well-to-do families. In respect of educational status, half of the oil palm orchardists were literates (54.22 per cent).

4.1.2 Particulars of Land Holding

Land is basic resource for agricultural production. Farm size is one of the crucial factors that affects the magnitude and efficiency of production and income of the farm families. The land holding particulars of the selected farmers are presented in Table 4.2 The average size of

Table 4.1 : Farm family composition of sample farmers

S.No	Particulars	Number	Percentage
1.	**Size of the family**		
	a. Males	2.86	39.56
	b. Females	2.25	31.12
	c. Children	2.12	29.32
	Total	**7.23**	**100.00**
2.	**Farm Family Workers**	**1.96**	**27.11**
	a. Males	1.14	15.77
	b. Females	0.82	11.34
	c. Children	—	—
3.	**Literacy level**	**3.92**	**54.22**

Table 4.2 : Land holding particulars of the sample farmers

S.No	Particulars	Area in hectares	Percentage
1.	Irrigated dry land	3.03	41.40
2.	Wet land	4.29	58.60
3.	Total holding	7.32	100.00
4.	Area under oil palm	4.38	59.84

holding was 7.32 hectares. The area under irrigated dryland was 3.03 hectares forming 41.40 per cent of total land holding. The area under wet land was 4.29 hectares accounting for 58.60 per cent of total holding. Oil palm which was a selected oilseed crop for this economic analysis occupied 4.38 hectares and this constituted 59.84 per cent of the total area under cultivation.

4.1.3 Farm Inventory

The value and composition of farm assets reflects economic background of farmers. The particulars of farm assets on per farm and per hectare basis are presented in Table 4.3.

It is observed that land is the major item of total assets. The value of land was Rs. 10,61,745.09 and Rs. 1,45,016.07 per farm and per hectare which accounted for 87.78 per cent of total assets. The respective figures for value of wells were Rs. 49,019.61 and Rs. 6,695.23 which formed 4.06 per cent of total value of assets. The value of machinery and implements was Rs. 38,497.27 and Rs. 5,258.05 (3.18 per cent) per farm and per hectare respectively. The value of irrigation equipment stood at Rs. 26,413.72 and Rs. 3,607.65 (2.18 per cent). This indicated that the oil palm orchardists gave top priority for working assets and for the development of irrigation facilities because oil palm requires continuous irrigation as it is a fast growing crop with high productivity and biomass production.

Table 4.3 : Asset structure of sample farmers

S.No.	Particulars	Per farm (Rs.)	Per hectare (Rs.)
1.	**Value of land**	**1061745.09 (87.78)**	**145016.07 (87.78)**
	a. Dry land	307686.27 (25.44)	42024.64 (25.44)
	b. Wet	754058.82 (62.34)	102991.43 (62.34)
2.	Value of wells	49019.61 (4.06)	6695.23 (4.06)
3.	Value of farm buildings	10066.67 (0.83)	1374.93 (0.83)
4.	Value of irrigation equipment	26413.72 (2.18)	3607.65 (2.18)
5.	Value of machinery and implements	38497.27 (3.18)	5258.05 (3.18)
6.	Value of live stock	23772.75 (1.97)	3246.95 (1.97)
7.	**Value of assets**		
	a. With land	1209515.12 (100.00)	165198.88 (100.00)
	b. Without land	147770.02 (12.22)	20182.81 (12.22)

The total value of assets per farm with and without land was Rs. 12,09,515.12 and Rs. 1,47,770.02 respectively whereas the same per hectare was Rs. 1,65,198.88 and Rs. 20,182.81.

4.2 HUMAN LABOUR AND MATERIAL INPUT UTILISATION ON OIL PALM ORCHARDS

4.2.1 Human labour utilisation on oil palm orchards

Human labour is one of the important factors of production and also a major cost component that influences the cultivation of any crop. Successful completion of every agricultural operation requires some amount of human labour. The human labour use depends upon 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 oil palm cultivation.

4.2.1.1 Human labour utilisation on oil palm orchard during pre-bearing period (1-4 years)

The operation wise labour utilisation in the cultivation of oil palm during pre-bearing period is presented in Table 4.4. The total labour utilised for the establishment of oil palm during first year was 106.68 man days per hectare. It is noted that the watch and ward was the most labour absorbing operation requiring 15 man days per hectare accounting for 14.06 per cent of total labour used during the first year. It was observed that most of the oil palm farmers used to grow some intercrops

like pulses, banana (dwarf cavendish), chillies, tomato, watermelon, cotton etc. upto 3rd year. Watch and ward had to be kept especially to avoid browsing of intercrops and to protect the young seedling from stray cattle because the most critical stage in oil palm plantation is from the time of planting till the establishment. They gave importance to intercrops during pre-bearing period of oil palm because intercrops helps in soil conservation, prevent weeds and also give income to the farmer till the oil palm comes to yield.

Fencing and fence maintenance was the next important labour absorbing operation. During the period of establishment, the oil palm saplings and the intercrop should be protected from livestock (or) stray cattle. Therefore fencing is needed and this operation consumed 14.62 man days accounting for 13.71 per cent of total labour used.

Weeding which involved digging of earth around the plant and the preparation of basins for irrigation was the next important labour absorbing operation. Weeding in oil palm orchards was done manually and farmers employed greater man days of human labour for weeding for better establishment and growth of oil palm plants. This operation required 14.58 man days accounting for 13.67 per cent of total labour used during the first year.

To plant oil palm saplings 2' x 2' x 2' sized pits were dug. Oil palm is planted in the main field in a triangular system at a spacing of 9 meters accommodating 143 palms per hectare. The digging of the pits required 14.29 man days (13.39 per cent of the total human labour). The pits were filled with 250 g of DAP, 250 g of rock phosphate and phorate granules mixed with soil. Clearing of bushes and removal of thorny plants was taken up for smooth ploughing. After ploughing, levelling was done as a part of land preparation and this cultural operation required 12.55 man days (11.76 per cent).

The planting and gap filling operation involved placing the sapling in the pit and refilling it with FYM and soil mix. To compensate the mortality of seedlings, orchardists resorted to gap filling. It needed 9.30 man days (8.72 per cent). Transportation and application of manures required 9 man days (8.44 per cent). About 5.76 man days (5.40 per cent) of labour was used for irrigation. Oil palm cultivation was chiefly taken up by the well-to-do farmers, hence they used drip irrigation system, so the labour requirement was less for irrigation in oil palm cultivation. Inter culture required 4.23 man days (3.97 per cent). It was done by tractor in cris cross wise in between seedlings. This was done once in a year to increase the water retention capacity of the soil.

The other important labour absorbing operation during the year of establishment included marking of lines and alignment and fertilisation. Marking of lines and alignment needed 3.00 man days (2.81 per cent) followed by fertilisation with 2.51 man days (2.35 per cent). Only 1.39 man days of labour were needed for plant protection and it formed 1.30 per cent to the total labour requirement. Transportation of plant material needed 0.45 man days (0.42 per cent).

The total labour requirement was increased from 2nd year to 4th year. Total labour utilised during 2nd, 3rd and 4th year stood at 58.09, 65.64 and 78.33 man days per hectare respectively. Major item of human labour utilisation during 2nd, 3rd & 4th year was watch and ward, accounting for 15 man days (25.82 per cent), 18 man days (27.42 per cent) and 21 man days (26.81 per cent) respectively. Yields started coming from 3rd year onwards hence the labour utilized increased for watch and ward. Labour is employed 10-15 days before the commencement of harvesting of fruits. There are serious non insect pests like monkeys, bats and birds which damage the oil palm fresh fruit bunches. There is no satisfactory control measure except scaring them using labour.

Weeding was the next labour consuming operation requiring 13.10 man days (22.55 per cent), 12.51 man days (19.06 per cent), and 13.34

man days (17.03 per cent) in 2nd, 3rd and 4th year respectively. This operation was done frequently for proper establishment of oil palm seedlings.

The third important labour consuming operation was interculture. Intercultivation was done around the saplings and between the saplings using a spade by digging slightly the upper soil layer and widening the basins. This cultural operation enables better infiltration of water, loosening the upper soil and preventing weed growth which needs 8.53 man days (14.68 per cent), 8.64 man days (13.16 per cent) and 9.84 man days (12.56 per cent) in 2nd, 3rd and 4th years respectively which was increased in 2nd, 3rd, 4th years as against 4-23 man days in the 1st year. This is attributed to the reason that, with the growth of plants the basin areas around each plant increases and hence the requirement of intercultivation to avoid the competition between oil palm and weeds.

Manuring was the next labour absorbing operation which required 8.47 man days (14.58 per cent), 8.64 man days (13.16 per cent) and 7.77 man days (9.92 per cent) respectively during 2nd, 3rd and 4th years of prebearing period. Manuring was done after weeding. Generally oil palm, starts yields from 4th year onwards. But due to improved cultivation practices, even in third year also some yield was obtained. For harvesting the fruits during 3rd and 4th year about 9.38 man days (3.04 per cent) of labour were utilised.

Irrigation was the next labour consuming operation requiring over 22.32 man days during prebearing period (7.23 per cent). The labour requirement for irrigation was almost same during four years. Drip irrigation need not require more number of human labour as there is no need to maintain channels.

The farmers use local material such as prosofis for fencing which could be damaged by cattle necessiating maintenance of fence and this required 11.76 man days in 2nd, 3rd and 4th years as against 14.62 man days (13.71 per cent) in the 1st year. Fertilizer application required a total of 10.44 man days (3.38 per cent) from 1st to 4th year and this was followed by plant protection which required 5.69 man days (1.84 per cent) during prebearing period. Generally incidence of pests and diseases are very low in oil palm, hence low requirement for plant protection.

Pruning of leaf starts from 3rd year onwards. It required 3.61 man days (5.50 per cent) and 3.68 man days (4.70 per cent) in 3rd and 4th year respectively. When the palms start yielding, judicious pruning to retain about 40 leaves on the crown is advocated. In addition dead and excess leaves should be cut off and crowns should be cleaned at least once in a year.

Table 4.4 : Operation wise human labour utilisation on oil palm orchards during pre-bearing period (1st to 4th year)

(Man days / ha)

S. No	Operation	1st Year	2nd Year	3rd Year	4th Year	Total
1.	Ploughing Cleaning and levelling	12.55 (11.76)				12.55 (4.07)
2.	Marking of lines and alignment	3.00 (2.81)				3.00 (0.97)
3.	Digging of pits	14.29 (13.39)				14.29 (4.63)
4.	Transportation of plant material	0.45 (0.42)				0.45 (0.15)
5.	Planting and Gap filling	9.30 (8.72)				9.30 (3.01)
6.	Manuring	9.00 (8.44)	8.47 (14.58)	8.64 (13.16)	7.77 (9.92)	33.88 (10.97)
7.	Fertilisation	2.51 (2.35)	2.47 (4.25)	2.66 (4.05)	2.80 (3.57)	10.44 (3.38)
8.	Weeding	14.58 (13.67)	13.10 (22.55)	12.51 (19.06)	13.34 (17.03)	53.53 (17.34)
9.	Interculture	4.23 (3.97)	8.53 (14.68)	8.64 (13.16)	9.84 (12.56)	31.24 (10.12)
10.	Irrigation	5.76 (5.40)	5.48 (9.43)	5.49 (8.37)	5.59 (7.14)	22.32 (7.23)
11.	Plant protection	1.39 (1.30)	1.33 (2.30)	1.39 (2.12)	1.58 (2.02)	5.69 (1.84)
12.	Fencing and Fence maintenance	14.62 (13.71)	3.71 (6.39)	3.83 (5.83)	4.22 (5.39)	26.38 (8.54)
13.	Watch and ward	15 (14.06)	15 (25.82)	18.00 (27.42)	21.00 (26.81)	69.00 (22.35)
14.	Leaf pruning	—	—	3.61 (5.50)	3.68 (4.70)	7.29 (2.36)
15.	Harvesting	—	—	0.87 (1.33)	8.51 (10.86)	9.38 (3.04)
	Owned Labour	27.79 (26.05)	23.24 (40.01)	26.70 (40.68)	27.77 (35.45)	105.49 (34.17)
	Hired Labour	78.89 (73.95)	34.85 (59.99)	38.94 (59.32)	50.56 (64.55)	203.24 (65.83)
	Total	106.68 (100.00)	58.09 (100.00)	65.64 (100.00)	78.33 (100.00)	308.73 (100.00)

Note : Figures in parentheses indicate percentages to total.

During the prebearing period, the hired labour contribution in total labour varied from 59.99 per cent in the 2nd year to 64.55 per cent in 4th year.

Total labour required during prebearing period was about 308.73 man days. Of which 34.17 per cent family labour and the remaining 65.83 per cent hired labour.

4.2.1.2 Human labour utilisation per hectare of oil palm orchard during bearing period (5th to 25th year)

The operation wise human labour requirement per hectare of the oil palm orchard from 5th to 25th year is presented in Table 4.5. As oil palm is being cultivated in the study area only from 1991, the data pertaining to the production aspects of oil palm orchards from 10th year onwards was assumed to be constant.

The major labour consuming operation was the harvesting which utilised 812.13 man days (37.31 per cent). As the age of orchard is progressing the more number of labour units were needed for harvesting of oil palm fresh fruit bunches which is taken up at an interval of 10-15 days.

Watch and ward was next to harvesting in labour utilisation. It required 421 man days of labour (19.34 per cent). There is no much difference in labour use for watch and ward from year to year as it depended on the area but not on the age of the orchard.

The third important labour consuming operation was weeding, which required 302.74 man days of labour accounting for 13.91 per cent of total labour utilisation. Weeding utilised 11.88 man days during 5^{th} year and then increased to 15 man days during 9^{th} year as the age of the root growth increases with the age of the orchard. The basin area of oil palm represents its active root growth zone which should be kept free from weeds by hand weeding. Weeding taken up twice a year can keep the weed growth under control effectively.

The labour requirement towards intercultivation was 134.81 man days (6.19 per cent). It decreased from 9.23 man days in 5^{th} year to 6.20 man days in 9^{th} year which was assumed constant after 9^{th} year. Next labour consuming operation was fence maintenance which utilised 129.90 man days (5.97 per cent) which was slightly increased from 5^{th} year to 9^{th} year.

Labour required for irrigation was 119.08 man days (5.47 per cent). There is no much difference in man days required for irrigation

... human labour utilisation on oil palm orchards during bearing period (5th to 25th year)

(Man days / ha)

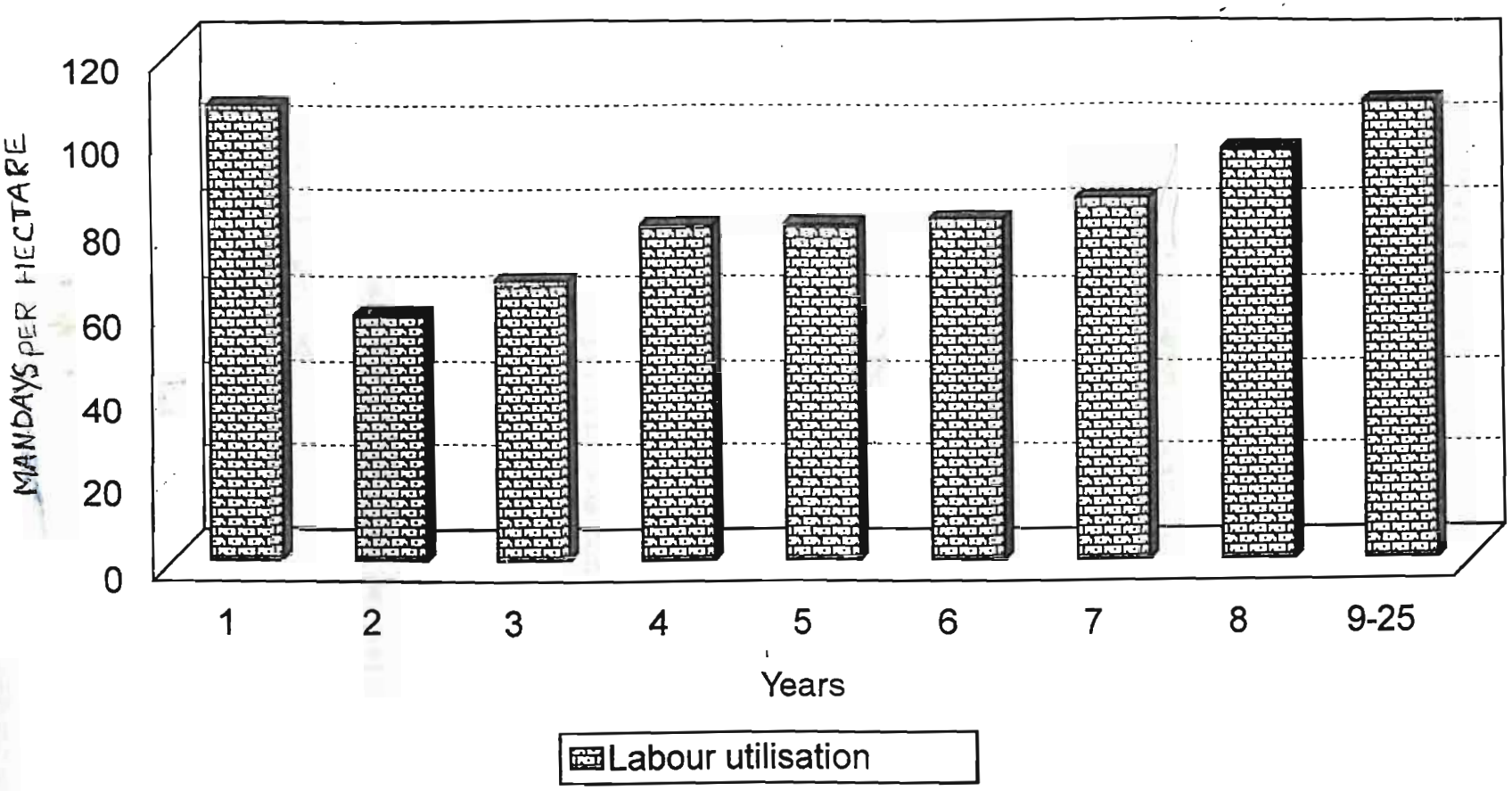
S. No.	Operations	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year
1.	Manuring	7.41 (9.41)	6.69 (8.34)	5.26 (6.21)	4.69 (4.86)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)
2.	Fertilisation	2.65 (3.37)	2.83 (3.53)	2.05 (2.42)	2.05 (2.12)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)
3.	Weeding	11.88 (15.09)	11.62 (14.49)	11.36 (13.41)	12.88 (13.33)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)
4.	Inter-cultivation	9.23 (11.72)	8.82 (10.99)	5.68 (6.70)	5,68 (5.88)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)
5.	Irrigation	5.50 (6.98)	5.54 (6.91)	5.57 (6.57)	5.57 (5.77)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)
6.	Plant protection	1.50 (1.90)	1.53 (1.91)	1.25 (1.48)	1.48 (1.53)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)
7.	Fence maintenance	4.11 (5.22)	4.83 (6.02)	5.00 (5.90)	5.46 (5.65)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)
8.	Watch and Ward	21.00 (26.67)	20.00 (24.93)	20.00 (23.60)	20.00 (20.71)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)
9.	Leaf pruning	3.99 (5.07)	3.21 (4.00)	2.05 (2.42)	2.27 (2.35)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)
10.	Harvesting	11.47 (14.57)	15.14 (18.88)	26.51 (31.29)	36.51 (37.80)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)
	Owned labour	27.42 (34.82)	26.98 (33.64)	26.93 (31.78)	27.39 (28.36)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)
	Hired labour	51.33 (65.18)	53.23 (66.36)	57.80 (68.22)	69.20 (71.64)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)
	Total	78.75 (100.00)	80.21 (100.00)	84.73 (100.00)	96.59 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)

Note : Figures in parentheses indicate percentages to total

S. No.	Operations	16th year	17th year	18th year	19th year	20th year	21st year	22nd year	23rd year	24th year	25th year	Total
1.	Manuring	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	4.80 (4.44)	105.65 (4.85)
2.	Fertilisation	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	2.45 (2.26)	51.23 (2.35)
3.	Weeding	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	15.00 (13.89)	302.74 (13.91)
4.	Inter-cultivation	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	6.20 (5.74)	134.81 (6.19)
5.	Irrigation	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	5.70 (5.28)	119.08 (5.47)
6.	Plant protection	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	1.50 (1.39)	31.26 (1.44)
7.	Fence maintenance	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	6.50 (6.02)	129.90 (5.97)
8.	Watch and Ward	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	20.00 (18.51)	421.00 (19.34)
9.	Leaf pruning	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	3.38 (3.13)	68.98 (3.17)
10.	Harvesting	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	42.50 (39.34)	812.13 (37.31)
	Owned labour	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	30.05 (27.82)	619.57 (28.46)
	Hired labour	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	77.98 (72.18)	1557.22 (71.54)
	Total	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	108.03 (100.00)	2176.79 (100.00)

Note : Figures in parentheses indicate percentages to total

Fig. 4.1 : Labour utilisation on oil palm orchards during its economic life period (1-25 years)



as most of the farmers used drip irrigation. There is no need of maintenance of channels.

Manuring required 105.65 man days (4.85 per cent). Manuring utilised 7.41 man days (9.41 per cent) during 5th year then decreased to 4.8 man days. As the age of the orchard advanced, farmer did not take much care towards manuring because they are practising mulching with dried oil palm leaves, empty bunches and male flowers. When incorporated, these materials also improve organic matter content of soil and plant nutrient status. When the palm started yielding, judicious pruning has to be done and this operation required 68.98 man days (3.17 per cent). The next labour utilising operation was fertilisation which required 51.23 man days (2.35 per cent). The last item of labour utilisation was pesticide application which required 31.26 man days (1.44 per cent).

Total labour utilisation during bearing period was about 2176.79 man days per hectare of which 28.46 per cent was contributed by family labour and the rest by (71.54 per cent) hired labour.

4.2.1.3 Human labour utilisation on oil palm orchards during its economic life period

The total labour requirement for the cultivation of oil palm during its economic life span of 25 years was 2,485.52 man days per hectare. It

Table 4.6 : Operation wise human Labour utilisation on oil palm orchards during its economic life period (25 years)

(Man days / ha)

S. No	Operation	Units	% of Total
1.	Cleaning and levelling	12.55	0.51
2.	Marking of lines and alignment	3.00	0.12
3.	Digging of pits	14.29	0.57
4.	Transportation of plant material	0.45	0.02
5.	Planting and Gap filling	9.30	0.38
6.	Manuring	139.53	5.61
7.	Fertilisation	61.67	2.48
8.	Weeding	356.27	14.33
9.	Interculture	166.05	6.68
10.	Irrigation	141.40	5.69
11.	Plant protection	36.95	1.49
12.	Fencing and Fence maintenance	156.28	6.29
13.	Watch and ward	490.00	19.71
14.	Leaf pruning	76.27	3.07
15.	Harvesting	821.51	33.05
	Owned Labour	725.06	29.17
	Hired Labour	1760.46	70.83
	Total	**2485.52**	**100.00**

is clear from the table 4.6 that the major labour absorbing cultural practices were harvesting, watch and ward, weeding, interculture and fencing and fence maintenance as more than 80 per cent of the total labour was used in these operations. It is further revealed that maximum labour days were absorbed by harvesting operation clubbed with watch and ward (1,311.51 man days) followed by weeding and interculture (522.32 man days) and fencing and fence maintenance (156.28 man days) accounting for 52.76, 21.01 and 6.29 per cent of total labour utilised for the entire 25 years period. The other important labour absorbing operations were irrigation 141.40 man days, manuring (139.53 man days), leaf pruning (76.27 man days), fertilisation (61.67 man days) and plant protection (36.95 man days). The operations performed only once in the life period of the orchard were ploughing, cleaning and levelling, marking of lines and alignment, digging of pits, transportation of plants and planting and gap filling. Further it is observed that the involvement of family labour and hired labour was 725.06 and 1760.46 man days per hectare accounting for 29.17 and 70.83 per cent of the total human labour consumed in oil palm production.

4.2.2 Material input utlisation on oil palm orchards

The material inputs utilised in the oil palm cultivation were plant material, FYM, fertilizers and plant protection chemicals. The table 4.7 shows the input utilisation on oil palm orchards.

Plant population is maintained on par with the recommended plant population which is 143 plants per hectare. The quantity of manures varied between 5.5 tonnes during initial years to 7-8 tonnes per annum per hectare during later stages of orchard. With regards to fertilizer application, about 169.2 kg of N, 84.6 kgs of P_2O_5 and 170 kgs of K_2O per hectare per year for adult palm are recommended by horticultural department. One third of it is applied during first year, two thirds during second year and full dose from third year in two splits is recommended.

It is observed that most of the farmers followed the recommended dosages of material inputs. Generally infestation is less in oil palm orchards. In the case of infested orchards, farmers used 6 litres of liquid pesticides. Some of the farmers were found to use mixer of castor cake powder, toddy, furadon granules to reduce the red palm weevil infestation. Growing of oil palm orchards is being considered as ecofriendly as the usage of pesticides is very less.

From the foregoing explanation it is clearly understood that the technical knowledge about material input utilisation imparted by the extension staff has been properly implemented by the farmers.

Table 4.7 : Material input utilisation on oil palm orchards during pre-bearing period (1st to 4th year)

(per hectare)

S.No	Particulars	1st year	2nd year	3rd year	4th year	Total
1.	Plant material (No.)	141.84	—	—	—	141.84
2.	Manures (tonnes)	5.50	7.65	7.75	7.763	28.66
3.	Fertilizer (Kgs)					
	N	50.49	100.29	147.97	146.52	445.27
	P	28.05	55.37	82.224	82.27	247.91
	K	51.36	102.69	152.39	155.04	461.48
4.	Plant Protection Chemical (ml)	250	200	134	220	804

Table 4.8 : Material input utilisation on oil palm orchards during bearing period (5th to 25th year)

(per hectare)

S. No	Particulars	5th year	6th year	7th year	8th year	9th year	10th year	11th year	12th year	13th year	14th year	15th year
1.	Manures (tonnes)	8.22	7.41	7.35	7.35	7.20	7.20	7.20	7.20	7.20	7.20	7.20
2.	**Fertilizers (Kgs)**											
	N	150.17	146.18	146.89	147.41	147.41	147.41	147.41	147.41	147.41	147.41	147.41
	P	82.22	84.00	84.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00
	K	157.87	153.32	157.50	157.50	155.00	155.00	155.00	155.00	155.00	155.00	155.00
3	Plant protection chemical (ml)	223.5	210.20	227.70	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00

S. No	Particulars	16th year	17th year	18th year	19th year	20th year	21st year	22nd year	23rd year	24th year	25th year	Total
1.	Plant material (No)											141.84
2.	Manures (tonnes)	7.20	7.20	7.20	7.20	7.20	7.20	7.20	7.20	7.20	7.20	152.73
3.	**Fertilizers (Kgs)**											
	N	147.41	147.41	147.41	147.41	147.41	147.41	147.41	147.41	147.41	147.41	3096.62
	P	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	82.00	1728.22
	K	155.00	155.00	155.00	155.00	155.00	155.00	155.00	155.00	155.00	155.00	3261.19
4.	Plant protection chemical (ml)	250 00	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00	5161.4

4.3 COST STRUCTURE OF OIL PALM ORCHARDS :

Oil palm is a perennial oil seed crop and once established, the crop can be economically cultivated for about 25 years. The gestation period of oil palm orchard is about 3 years. The economic yields are coming from 5th year onwards. Therefore the cost incurred in establishing the orchard during the pre-bearing period was considered as establishment cost. The establishment cost included the expenditure on land preparation, digging of pits, plant material and planting, fencing and other subsequent nurturing operations for the plantation together with orchards. The maintenance costs included the expenditure on manuring, fertilisation, plant protection, irrigation, weeding, watch and ward and harvesting along with overheads from commercial bearing.

The profitability of an enterprise mostly depends on the relation between the costs incurred in running the enterprise and the returns obtained from it. The study of costs and returns of oil palm cultivation helps the farmers to plan future oil palm production programmes with a view to maximise net profits by adopting efficient resource management practices. Generally in any economic study total costs are discussed under two groups viz., variable cost and fixed costs. Variable costs include expenses on labour utilised for performing different cultural practices and expenditure on material inputs like planting material, FYM, fertilizers, plant protection chemical etc. The fixed costs are

depreciation on working assets, interest on fixed capital, rent on owned land, land revenue and annual share of establishment cost.

4.3.1 Cost of cultivation of oil palm during pre-bearing period (1-4 years)

The costs incurred in establishing oil palm orchards during pre-bearing period (1-4 years) are presented in Table 4.9.

The total costs expended per hectare of oil palm during its pre-bearing period (1-4 years) stood at Rs. 77,899.64 of which Rs. 49,415.45 (63.43 per cent) were variable costs and Rs. 28,484.19 (36.57 per cent) fixed costs.

It can be seen that among total costs the rental value of owned land formed the major item with Rs. 16,045.17 (20.60 per cent) followed by fertilizers (15.18 per cent), human labour (12.75 per cent), plant material cost (10.92 per cent), interest on fixed capital (10.36 per cent), interest on working capital (9.26 per cent), manures (7.70 per cent), electricity charges (5.69 per cent), annual share of establishment cost (3.55 per cent), depreciation (1.66 per cent) machine labour (1.54 per cent), land revenue (0.40 per cent), pesticides (0.23 per cent), and bullock labour (0.16 per cent).

The total costs incurred to establish one hectare of oil palm during first year amounted to Rs. 27,536.34 out of which Rs. 20,124.21 (73.08 per cent) was spent on variable resources and the remaining Rs. 7,412.13 (26.92 per cent) pertained to fixed costs. Among the variable costs, plant material cost took a lion's share with Rs. 8,510.20 which accounted for 30.90 per cent of total costs incurred during 1st year of establishing oil palm. The sample farmers procured plant material from Nellore, Podalakur and Kavali. The tenera variety is widely used in the study area due to its high mesocarp content and resultant high oil outturn. The actual cost of each seedling was about Rs. 60, but in the study area the horticultural department supplied oil palm seedlings to the farmers at a subsidised rate of Rs. 15 per plant. All the sample farmers followed the recommended plant population of 143 palms per hectare.

Next to plant material, human labour was the second major item of variable costs constituting 15.05 per cent of the total cost with an amount of Rs. 4,145.73 followed by interest on working capital, (Rs. 2,902.63), fertilizers (Rs. 1,326.66), manures (Rs. 1,150.00), electricity charges (Rs. 1,133.30), machine labour (Rs. 864.96), pesticides (Rs. 50.73), and bullock labour (Rs. 40). The operations such as land preparation, digging of pits, planting etc. required more human labour and hence the expenditure incurred on human labour was higher in the first year of establishment of oil palm orchard.

Among the fixed costs, the rental value of owned land occupied the first place with Rs. 4,994.37 (18.14 per cent) followed by interest on fixed capital with Rs. 2,018.28 (7.33 per cent), depreciation charges with Rs. 324.15 (1.18 per cent) and land revenue (Rs. 75.33).

The cost incurred to maintain one hectare of oil palm orchard during the remaining years of pre-bearing period (2 to 4 years) stood at Rs. 15,946.26, Rs. 17,874.19 and Rs. 16,542.85 respectively during 2^{nd}, 3^{rd} and 4^{th} years. The respective total variable costs on an average per hectare during the above said years were Rs. 8,479.03, Rs. 10,126.03 and Rs. 10,686.18 whose percentages ranged from 53 to 65 per cent of the total costs incurred. In second, third and fourth years fertilizer cost turned out to be the major item of variable cost which worked out to Rs. 2,644.32 (16.58 per cent), Rs. 3,944.09 (22.07 per cent) and Rs. 3,909.07 (23.63 per cent) respectively. The cost of fertilizers increased from 2^{nd} year to 3^{rd} year and almost remained constant during fourth year. The reason for high fertilizer application in oil palm orchards is that oil palm is a gross feeder which demands a balanced and adequate supply of fertilizer during the initial stages of its life i.e pre-bearing period.

Next to the cost of fertilizers, human labour found to be the major item of the cost in 2^{nd}, 3^{rd} and 4^{th} years of pre-bearing period. The cost of human labour increased from Rs. 1,700.81 (10.67 per cent) during 2^{nd}

year to Rs. 1,779.39 (9.96 per cent) in 3rd year and Rs. 2,302.87 (13.92 per cent) during 4th year. The operations such as weeding, interculture (bunding around plants, cleaning of basins etc.), watch and ward and harvesting in 4th year, required more human labour and hence the expenditure on human labour increased with the age of the garden.

Manures were the third important item of variable expenditure from 2nd year onwards during pre-bearing period. The cost of manures was almost same during 2nd, 3rd and 4th years during pre-bearing period which stood around Rs. 1,600.00. The other important item of variable cost was interest on working capital amounting to Rs. 1,255.82 (7.88 per cent), Rs. 1,484.26 (8.30 per cent) and Rs. 1,574.69 (9.52 per cent) respectively followed by electricity charges for irrigation worked out at Rs. 1,121.44 (7.03 per cent), Rs. 1,119.03 (6.26 per cent) and Rs. 1,059.08 (6.40 per cent) during the above said years of pre-bearing period. Oil palm requires adequate and frequent irrigations as it is fast growing crop. The other items of variable costs were machine labour, bullock labour, and pesticides accounting for about 0.6, 0.4 and 0.3 per cent of total costs.

Rental value of owned land formed the major part of fixed costs during 2nd to 4th year. It accounted for 25.88 per cent, 24.66 per cent and 15.21 per cent of total costs respectively during 2nd, 3rd and 4th

Table 4.9 : Cost structure on oil palm orchards during pre-bearing period (1st to 4th year)

(Rs/ha)

S. No	Parti-culars	1st Year	2nd Year	3rd Year	4th Year	Total
A.	**Variable costs**					
1	Human Labour	4145.73 (15.05)	1700.81 (10.67)	1779.39 (9.96)	2302.87 (13.92)	9928.8 (12.75)
	Owned	468.82 (1.70)	258.92 (1.62)	271.87 (1.52)	263.60 (1.59)	1263.21 (1.62)
	Hired	3676.91 (13.35)	1441.89 (9.05)	1507.52 (8.44)	2039.27 (12.33)	8665.59 (11.12)
2.	Bullock labour (owned)	40.00 (0.15)	15.47 (0.10)	25.60 (0.14)	43.20 (0.26)	124.27 (0.16)
3.	Machine Labour	864.96 (3.14)	101.01 (0.63)	116.40 (0.65)	121.04 (0.73)	1203.41 (1.54)
	Owned	587.03 (2.13)	62.10 (0.39)	78.39 (0.44)	56.48 (0.34)	784.00 (1.01)
	Hired	277.93 (1.01)	38.91 (0.24)	38.01 (0.21)	64.56 (0.39)	419.41 (0.54)
4.	Plant Material Cost	8510.20 (30.90)	—	—	—	8510.20 (10.92)
5.	Manures	1150.00 (4.18)	1600.00 (10.03)	1620.00 (9.06)	1623.20 (9.81)	5993.2 (7.70)
6.	Fertilizers	1326.66 (4.82)	2644.32 (16.58)	3944.09 (22.07)	3909.07 (23.63)	11824.14 (15.18)
7.	Pesticides	50.73 (0.18)	40.16 (0.25)	37.26 (0.21)	53.03 (0.32)	181.18 (0.23)
8.	Electricity charges	1133.30 (4.12)	1121.44 (7.03)	1119.03 (6.26)	1059.08 (6.40)	4432.85 (5.69)
9.	Interest on working capital	2902.63 (10.54)	1255.82 (7.88)	1484.26 (8.30)	1574.69 (9.52)	7217.40 (9.26)
	Total variable costs	20124.21 (73.08)	8479.03 (53.17)	10126.03 (56.65)	10686.18 (64.59)	49415.45 (63.43)

B.	**Fixed costs**					
1.	Land Revenue	75.33 (0.27)	75.33 (0.47)	75.33 (0.42)	75.33 (0.46)	301.32 (0.40)
2.	Rental value of owned land	4994.37 (18.14)	4126.81 (25.88)	4407.74 (24.66)	2516.25 (15.21)	16045.17 (20.60)
3.	Depre-ciation	324.15 (1.18)	324.15 (2.03)	324.15 (1.81)	324.15 (1.96)	1296.6 (1.66)
4.	Interest on fixed capital	2018.28 (7.33)	2018.28 (12.66)	2018.28 (11.30)	2018.28 (12.20)	8073.12 (10.36)
5.	Annual share of establish-ment cost	—	922.66 (5.79)	922.66 (5.16)	922.66 (5.58)	2767.98 (3.55)
	Total Fixed Costs	7412.13 (26.92)	7467.23 (46.83)	7748.16 (43.35)	5856.67 (35.41)	28484.19 (36.57)
	Total Costs (A+B)	**27536.34 (100.00)**	**15946.26 (100.00)**	**17874.19 (100.00)**	**16542.85 (100.00)**	**77899.64 (100.00)**

Note : Figures in parentheses indicate percentages to total.

years. The interest on fixed capital, annual share of establishment cost, depreciation charges and land revenue formed other important items of fixed costs in the order.

4.3.2 Cost structure on oil palm orchards during bearing period (5-25 years)

The cost of cultivation of oil palm per hectare from 5th to 25th year are presented in Table 4.10. Oil palm is being cultivated in study area since 1991, hence the data was available upto 9th year only. For the remaining years (10th to 25th year) constancy was assumed pertaining to the cultivation aspects.

It is revealed from the table that the total cost per hectare increased from Rs. 19,687.81 in 5th year to Rs. 27,406.5 in 9th year and remained constant during the remaining period of life. The variable costs increased from Rs. 10,837.77 (55.05 per cent) during fifth year to Rs. 12,241.08 (44.66 per cent) during 9th year per hectare. This rise in variable costs was on account of higher expenditure incurred on inputs and input services with each passing year. Though the operational costs continued to increase during bearing period in absolute terms, in relative terms, it declined from 55.05 per cent in 5th year to 44.66 per cent in total costs in 9th year. The fixed costs rose from Rs. 8,850.04 in 5th year to Rs. 15,165.42 per hectare in 9th year. It is interesting to note that the

share of fixed costs in total costs increased from 44.95 per cent in 5th year to 55.34 per cent in 9th year of orchard. This increase in fixed costs could be attributed to the steep rise in opportunity cost of owned land which was taken as 1/4th of gross produce obtained from orchard.

The fertilizer accounted for maximum expenditure during the bearing period. It is slightly increased from Rs. 3,960.33 in 5th year to Rs. 4,000.75 per hectare in 9th year. There is no much difference in use of fertilizer during bearing period. It is accounted for major expenditure because oil palm is gross feeder and demands a balanced and adequate supply of fertilizer for good growth and yield during bearing period. Human labour was the next major item of operational costs. Cost incurred on human labour increased continuously from Rs. 2,281.51 in 5th year to Rs. 3,352.01 per hectare in 9th year. However the proportionate increase in the expenditure on human labour remained more or less the same. The increase in labour cost was mainly due to increasing human labour requirement for harvesting operation and for weeding operation.

Eventhough expenditure on manures occupied higher portion in operational costs (Rs. 1,719.45 in 5th year to Rs. 1,537.50 in 9th year) its application has slightly declined during bearing period. As the age of orchards advanced farmer did not take much care towards manuring

because they resorted to mulching with dried oil palm leaves, empty bunches and with male flowers which improve organic matter content of soil and plant nutrient status.

Interest on working capital was the next major item of cost. It increased from Rs. 1,601.12 in 5th year to Rs. 1,806.44 per hectare in 9th year. Similar trends were observed for electricity charges, machine labour, pesticides and bullock labour during yield increasing period.

Among fixed costs, rental value of owned land took a lion's share and it increased from Rs. 5,509.62 (27.98 per cent) in 5th year to Rs. 11,825.00 (43.15 per cent) per hectare in 9th year. This increase is due to increased yield of oil palm during yield bearing period, hence the rental value of owned land also started rising steeply with each passing year. Interest on fixed capital was Rs. 7.63 per cent followed by annual share of establishment cost. Depreciation accounted for 1.22 per cent and land revenue for 0.28 per cent of total costs.

From the above discussion it can be concluded that 5th to 9th year was considered to be yield increasing period in the economic life of oil palm orchard demanding greater use of all inputs.

Table 4.10 : Cost structure on oil palm orchards during bearing period (5th to 25th years)

(Rs / ha)

S. No	Particulars	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year	11th Year	12th Year	13th Year	14th Year	15th Year
A.	Variable costs											
1	Human Labour	2281.51 (11.59)	2346.70 (11.11)	2460.23 (10.37)	2979.56 (11.79)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)
	Owned	238.48 (1.21)	275.07 (1.30)	230.68 (0.97)	252.28 (1.00)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)
	Hired	2043.03 (10.38)	2071.63 (9.81)	2229.55 (9.40)	2727.28 (10.79)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)
2	Bullock labour (owned)	32.00 (0.16)	64.53 (0.31)	—	—	—	—	—	—	—	—	—
3	Machine Labour	126.86 (0.64)	110.72 (0.52)	238.63 (1.01)	261.36 (1.03)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)
	Owned	71.08 (0.36)	33.93 (0.16)	102.27 (0.43)	102.27 (0.40)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)
	Hired	55.78 (0.28)	76.79 (0.36)	136.36 (0.57)	159.09 (0.63)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)
4	Manures	1719.45 (8.73)	1550.18 (7.34)	1537.50 (6.48)	1537.50 (6.08)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)
5	Fertilizers	3960.33 (20.12)	3922.18 (18.57)	3956.93 (16.67)	3962.05 (15.67)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)
6	Pesticides	54.93 (0.28)	50.15 (0.24)	55.68 (0.23)	61.36 (0.24)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)
7	Electricity charges	1061.57 (5.40)	1053.22 (4.99)	1136.36 (4.79)	909.09 (3.60)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)

8	Interest on working capital	1601.12 (8.13)	1570.34 (7.44)	1629.44 (6.87)	1684.14 (6.66)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)
	Total variable costs	10837.77 (55.05)	10668.02 (50.52)	11014.77 (46.42)	11395.06 (45.07)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)
B.	**Fixed costs**											
1	Land Revenue	75.33 (0.38)	75.33 (0.36)	75.33 (0.32)	75.33 (0.30)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)
2	Rental value of owned land	5509.62 (27.98)	7108.26 (33.66)	9375.00 (39.50)	10546.88 (41.72)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)
3	Depreciation	324.15 (1.65)	324.15 (1.53)	324.15 (1.37)	324.15 (1.28)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)
4	Interest on fixed capital	2018.28 (10.25)	2018.28 (9.56)	2018.28 (8.50)	2018.28 (7.98)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)
5	Annual share of establish-ment cost	922.66 (4.69)	922.66 (4.37)	922.66 (3.89)	922.66 (3.65)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)
	Total Fixed Costs	8850.04 (44.95)	10448.68 (49.48)	12715.42 (53.58)	13887.30 (54.93)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)
	Total	**19687.81 (100.00)**	**21116.70 (100.00)**	**23730.19 (100.00)**	**25282.36 (100.00)**	**27406.5 (100.00)**	27406.5 (100.00)	27406.5 (100.00)	27406.5 (100.00)	27406.5 (100.00)	**27406.5 (100.00)**	**27406.5 (100.00)**

Note : Figures in parentheses indicate percentages to total.

Contd.

S. No	Operation	16th Year	17th Year	18th Year	19th Year	20th Year	21st Year	22nd Year	23rd Year	24th Year	25th Year	Total
A.	Variable costs											
1	Human Labour	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.005 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	3352.01 (12.23)	67052.17 (12.07)
	Owned	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	283.82 (1.04)	5821.45 (1.05)
	Hired	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	3068.19 (11.19)	61230.72 (11.02)
2	Bullock labour (owned)	—	—	—	—	—	—	—	—	—	—	96.53 (0.02)
3	Machine Labour	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	294.03 (1.07)	5736.08 (1.03)
	Owned	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	115.05 (0.42)	2265.40 (0.41)
	Hired	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	178.98 (0.65)	3470.68 (0.62)
4	Manures	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	1537.50 (5.61)	32482.13 (5.84)
5	Fertilizers	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	4000.75 (14.60)	83814.24 (15.08)
6	Pesticides	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	100.00 (0.36)	1922.12 (0.35)
7	Electricity charges	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	1150.35 (4.20)	23716.19 (4.27)

8	Interest on working capital	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	1806.44 (6.59)	37194.52 (6.69)
	Total variable costs	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	12241.08 (44.66)	252013.98 (45.35)
B.	**Fixed costs**											
1	Land Revenue	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	75.33 (0.28)	1581.93 (0.28)
2	Rental value of owned land	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	11825.00 (43.15)	233564.76 (42.03)
3	Depre-ciation	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	324.15 (1.18)	6807.15 (1.22)
4	Interest on fixed capital	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	2018.28 (7.36)	42383.88 (7.63)
5	Annual share of establish-ment cost	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	922.66 (3.37)	19375.86 (3.49)
	Total Fixed Costs	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	15165.42 (55.34)	303713.58 (54.65)
	Total Costs (A+B)	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**27406.5 (100.00)**	**555727.56 (100.00)**

Note : Figures in parentheses indicate percentages to total.

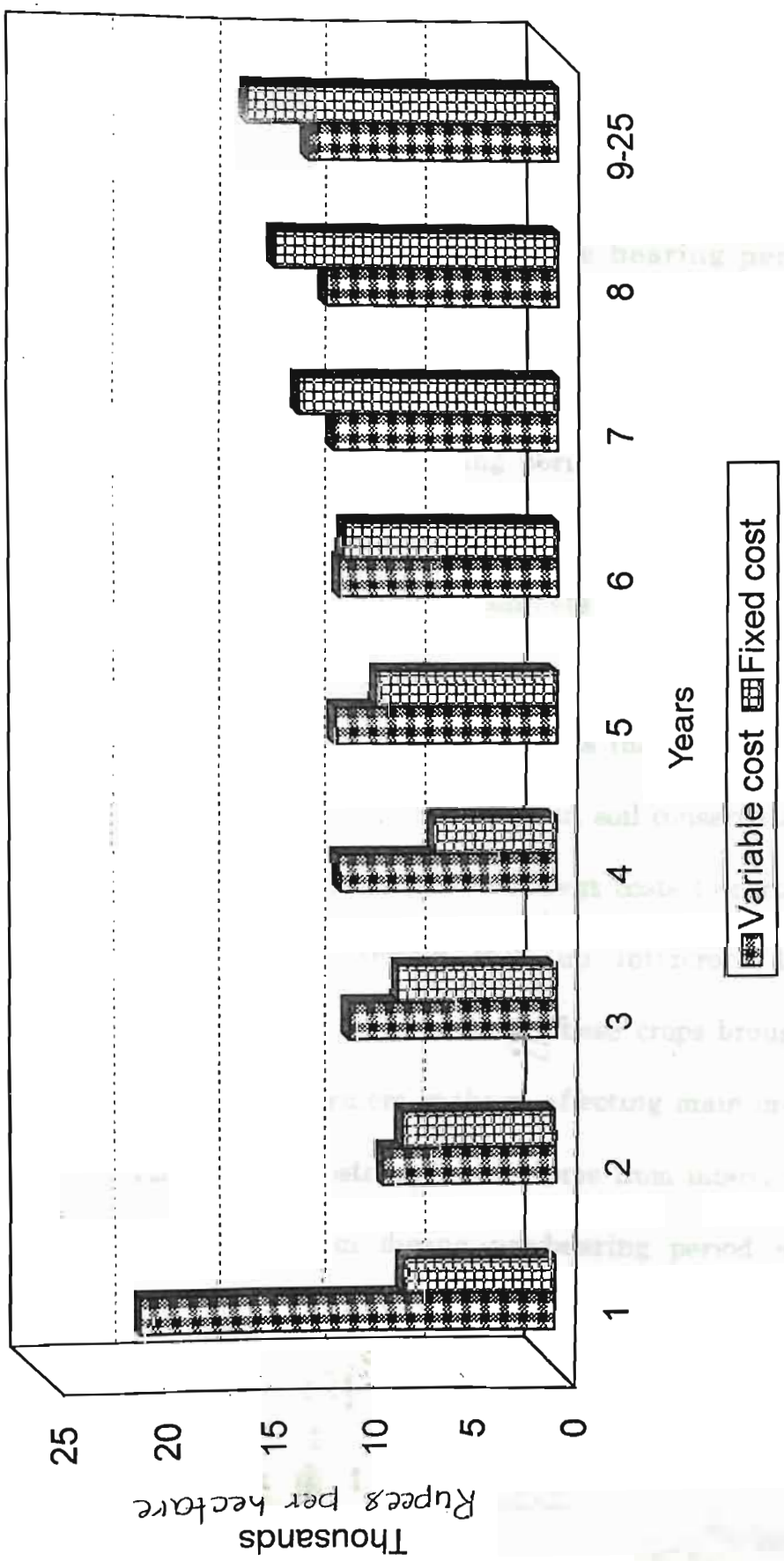


Fig. 4.2 : Cost structure on oil palm orchard during its economic life period (1-25 years)

The total costs incurred towards the cultivation of oil palm from 5th to 25th year worked out to Rs. 5,55,727.56 per hectare of which variable costs amounted to Rs. 2,52,013.98 (45.35 per cent) and fixed costs amounted to Rs. 3,03,713.58 (54.65 per cent).

4.4 RETURNS FROM OIL PALM ORCHARDS

4.4.1 Returns from oil palm orchards during pre bearing period (1-4 years)

Oil palm is a wide spaced perennial crop with a juvenile period of 3 years. Hence there is a good scope for utilizing horizontal and vertical space for growing intercrops. Crop selected for intercropping should be compatable with the main crop and should not compete with oil palm for light, water, nutrients, etc. Intercrops are the sources of income during early life of any orchard. It helps to cushion the costs incurred during the pre-bearing period of the orchard and also helps in soil conservation, and prevents weeds. To compensate the high establishment costs to certain extent in the pre-bearing period, farmers took up intercrops like groundnut, chillies, tomato, watermelon, cotton etc. These crops brought in reasonably good income to the farmers without affecting main crop. The per hectare gross income, total costs and net income from intercrops during 1st to 3rd year and oil palm during pre-bearing period are presented in Table 4.11.

Table 4.11 : Returns from oil palm orchards during pre bearing period (1st to 4th year)

(Rs/ ha)

S.No.	Particulars	1st year	2nd year	3rd year	4th year	Total
1.	**Gross Income**					
	Inter crops	19977.48	16507.24	17630.96	—	54115.68
	Oil palm	—	—	694.36	10065	10759.36
	Total	**19977.48**	**16507.24**	**18325.32**	**10065**	**64875.04**
2.	**Total Costs**					
	Inter crops	14584.98	10648.32	10767.69	—	36000.99
	Oil palm	27536.34	15946.26	17874.19	16542.85	77899.64
	Total	**42121.32**	**26594.58**	**28641.88**	**16542.85**	**113900.63**
3.	**Net Income**					
	Inter crops	5392.5	5858.92	6863.27	—	18114.69
	Oil palm	-27536.34	-15946.26	-17179.83	-6477.85	-67140.28
	Total	**-22143.84**	**-10087.34**	**-10316.56**	**-6477.85**	**-49025.59**

It is clear from the table 4.11 that the gross income obtained from oil palm orchards during its pre-bearing period, amounted to Rs. 64,875.04 per hectare out of which sale of intercrops during first three years contributed Rs. 54,115.68 and the remaining Rs. 10,759.36 was received from the sale of fresh fruit bunches of oil palm during 3rd and 4th years. A meagre yield of 0.25 tonnes and 3.66 tonnes of FFB was obtained during 3rd and 4th year respectively. It is also evident from the table that the oil palm orchardists incurred Rs.1,13,900.63 towards cost of cultivation of oil palm orchards during pre-bearing period out of which Rs. 36,000.99 were incurred to raise intercrops and Rs. 77,899.64 to establish one hectare of oil palm during its pre-bearing period. The income received during pre-bearing period of oil palm orchards could not compensate the costs incurred during the same period resulting in the negative net return of Rs. 49,025.59.

4.4.2 Returns from oil palm orchards during bearing period (5-25 years)

Oil palm has being cultivated in studied area since 1991; hence the data was available upto 9th year. The returns were assumed as constant from 10th to 25th year. The particulars of Table 4.12 indicated that the yield per hectare increased from 5th to 9th year. Yield increased from 8.014 tonnes in 5th year to 17.20 tonnes in 9th year. It was assumed constant from 10th to 25th year. During the same period the

Table 4.12 : Returns from oil palm orchards during bearing period (5^{th} to 25^{th} year)

(Rs / ha)

S. No	Particulars	5^{th} year	6^{th} year	7^{th} year	8^{th} year	9^{th} year	10^{th} year	11^{th} year	12^{th} year	13^{th} year	14^{th} year	15^{th} year
1	Yield (in tonnes)	8.014	10.34	13.64	15.34	17.20	17.20	17.20	17.20	17.20	17.20	17.20
2	Gross income (Rs.)	22038.50	28435.04	37500.0	42187.50	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00
3	Total Costs (Rs.)	19687.81	21116.70	23730.19	25282.36	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5
4	Net income (Rs.)	2350.69	7318.34	13769.81	16905.14	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50

S. No	Particulars	16^{th} year	17^{th} year	18^{th} year	19^{th} year	20^{th} year	21^{st} year	22^{nd} year	23^{rd} year	24^{th} year	25^{th} year	Total
1	Yield (in tonnes)	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	17.20	339.73
2	Gross income (Rs.)	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00	47300.00	934261.04
3	Total Costs (Rs.)	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5	27406.5	555727.56
4	Net income (Rs.)	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50	19893.50	378533.48

gross income also increased from 22,038.50 in 5th year to Rs.47,300 in 9th year. The range of net income was from Rs. 2,350.69 in 5th year to Rs. 19,893.50 in 9th year. The yield, gross and net incomes were increased during this yield increasing period i.e from 5th to 9th year.

4.4.3 Costs and returns from oil palm orchards during its economic life period (1-25 years)

The costs and returns from oil palm orchard during the economic life span of 25 years with subsidy and without subsidy are presented in Table 4.13.

To encourage oil palm cultivators in the study area, the Department of Horticulture provides plant material and fertilizers at subsidised rates during the pre-bearing period. The total subsidy amount works out to be Rs. 16,250 per hectare. Rs. 6,000 towards plant material and Rs. 10,250 towards fertilizers.

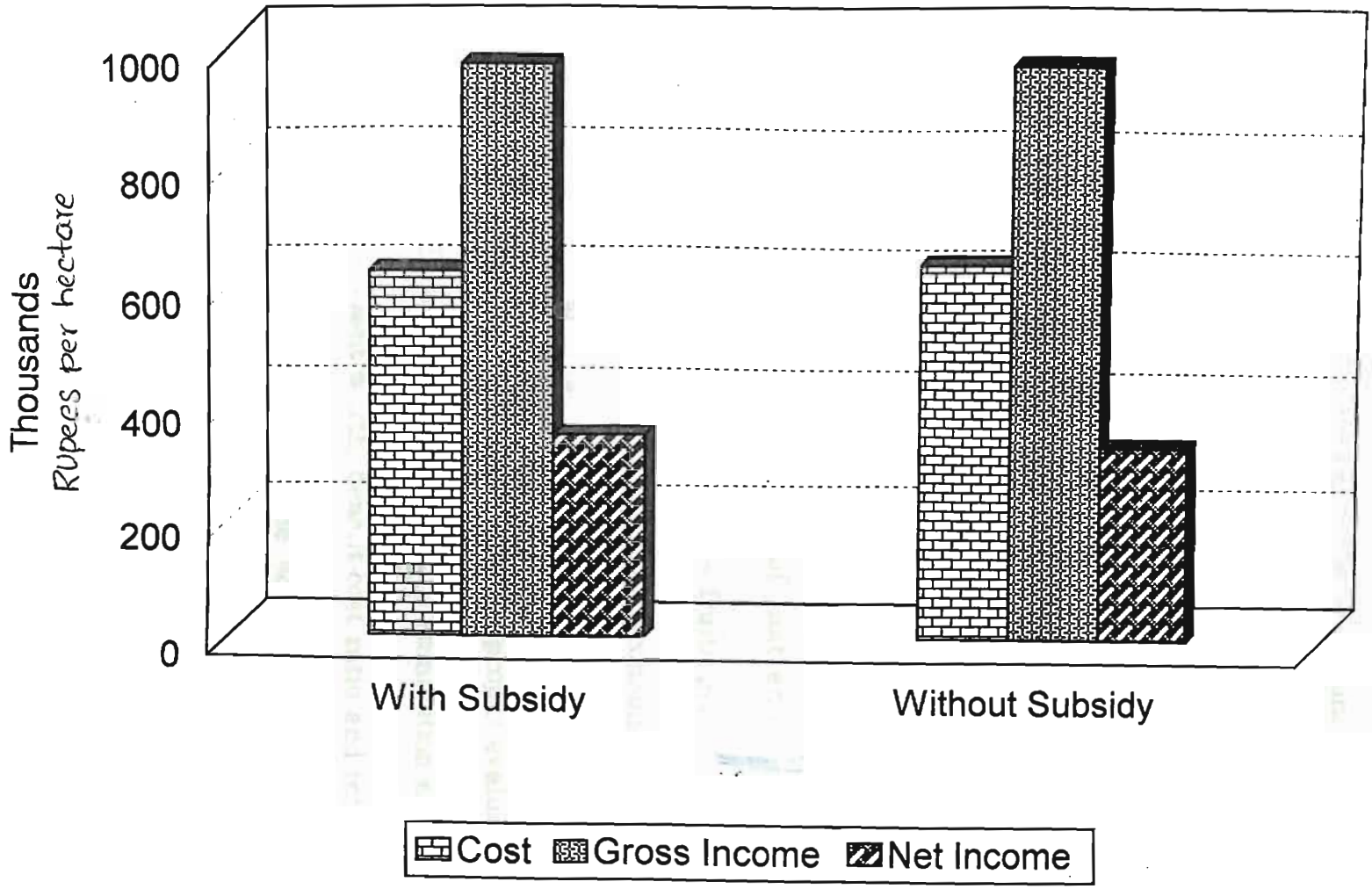
It is clear from the table 4.13 that the oil palm orchardists in the study area spent on an average Rs. 6,33,627.20 and Rs. 6,17,377.12 towards the cultivation of one hectare of oil palm during its life span of 25 years without subsidy and with subsidy respectively. The gross income realised by the oil palm orchardists during its lifespan amounted to Rs. 9,63,135.09 per hectare which included the net income from

Table 4.13 : Costs and returns from oil palm orchard during its economic life period (25 years)

(Rs / ha)

S.No.	Particulars	With subsidy	Without subsidy
1.	Costs	617377.2	633627.20
2.	Gross income	963135.09	963135.09
3.	Net income	345757.89	329507.89

Fig. 4.3 : Cost and returns from oil plam orchard during its economic life period (1-25 years)



intercrops during its pre-bearing period and oil palm fresh fruit bunches from third year onwards. The respective net incomes received by the farmers without and with subsidy stood at Rs. 3,29,507.89 and Rs.3,45,757.89. The subsidy is being provide as an incentive to the oil palm growers to encourage them to extend the area under oil palm cultivation.

4.5 ECONOMIC VIABILITY OF OIL PALM ORCHARDS

The costs and returns are not the perfect measures to assess the profitability from investment made on oil palm orchard. These cost and returns are not comparable with the returns from field crop that are grown in the area. Before making a choice on any enterprise, it becomes necessary to examine the economic feasibility of that enterprise. The length of the period a particular enterprise bears fruits play a key role in the selection of indicators that would examine the economic feasibility of the enterprise. Several techniques are available for evaluating the economic viability of oil palm orchards. For this study, project evaluation techniques were employed. Besides, the present value summation method commonly used namely net present worth, benefit-cost ratio and internal rate of return were employed to examine the economic feasibility of investment on oil palm orchards. The values are presented in Table 4.14.

In the present study the costs and returns had been discounted at 12, 14, 16, 18, 20, 22 and 24 per cent to estimate net present worth.

4.5.1 Net present worth :

It was observed from Table 4.14 that the net present worth was high and ranged from Rs. 65,201.48 at 12 per cent to Rs. 15,103.41 at 24 per cent discount rates. The high positive net present worth (NPW) even at higher discount rates indicated the soundness of the investment made in oil palm orchards.

4.5.2 Benefit-cost ratio :

The benefit-cost ratios were 1.358, 1.321, 1.286, 1.253, 1.223, 1.193 and 1.166 at 12, 14, 16, 18, 20, 22 and 24 per cent discount rates respectively. The benefit-cost ratio was more than unity at all the discount rates.

Even at a higher discount rate of 24 per cent it was 1.166 showing that a rupee invested in oil palm orchard would fetch Rs. 1.166 and this proved profitability of oil palm cultivation. So the investment on oil palm cultivation was economically feasible.

4.5.3 Internal rate of return :

The internal rate of return was found to be 39.19 per cent which was much higher than the bank rate of interest on long term loans (14 per cent) and hence the oil palm enterprise is economically feasible

Table 4.14 : Estimates of economic viability of oil palm orchard

S.No	Particulars	Discount rates						
		12%	14%	16%	18%	20%	22%	24%
1	Net present worth (Rs.)	65201.48	50698.61	39645.43	31125.43	24540.44	19261.91	15103.41
2.	Benefit Cost Ratio	1.358	1.321	1.286	1.253	1.223	1.193	1.166
3.	IRR	39.19%						

It is evident from the above discussion that the investment on oil palm orchard is a profitable proposition.

4.6 PROCESSING ASPECTS OF OIL PALM :

The data to work out the cost of processing was obtained from the lone processing unit located at Manubolu Nellore district. The detailed procedure of oil palm processing was discussed below (Fig. 4.4).

The common method of oil palm processing is known as dry process where in the oil is extracted mechanically by the hydraulic process or continuous screw process. The fruits should be processed with in 24 hours of harvesting to obtain good quality oil. Delay in processing, over ripening of fruits, damaged fruits, storage of fruits etc results in deterioration of oil content. The minimum size of oil processing mills available is 3 tonnes of Fresh Fruit Bunchers (FFB) per hour. A minimum of 200 hectare plantations are required to make such a unit economically viable. Simhapuri Agro Products (Pv) Ltd. processing unit in Nellore district was established with a capacity of 5 tonnes per hour. The processing consists of the following steps.

Sterilization :

It is done by heating with steam pressure of 3 kg/cm^2 for a duration of 40-60 minutes. The purpose of this operation is to deactivate the enzyme lipase which would raise the free fatty acid content.

Striping :

After sterilization the bunches must be stripped. This process involves the separation of the fruits from the bunches by passing through a rotated rotary drum stripper. The empty bunches are thrown outside through conveyor belt.

Digestion :

The purpose of digestion is to disrupt the mesocarp and to breakup the maximum number of oil bearing cells to facilitate oil release. This process also frees the nuts from the fibre. Digester is a vertical steam jacketed cylinder provided with beater arms and situated directly over the screw press. The digester comprises of cylindrical vessel in which rotating knives pulverise the fleshy part of the fruit into pulp and at the same time gets heated with injected steam. This releases the oil from the pulp and raise the temperature upto 95°C ; to increase the fluidity of the oil.

Pressing or oil extraction :

The digested pulp material automatically passes through the screw press where the liquid component is separated from the solid. The continuous screw press consists one or more screws turning with a perforated cage through which the oil water mixture is extracted.

Clarification :

The crude oil from the screw press contains a mixture of oil, water, cell debris and particles of fibre and shell. It is first passed through a double vibrating screen to remove particles. Hot water is then added and oil is allowed to separate in clarification tanks due to the difference in specific gravity.

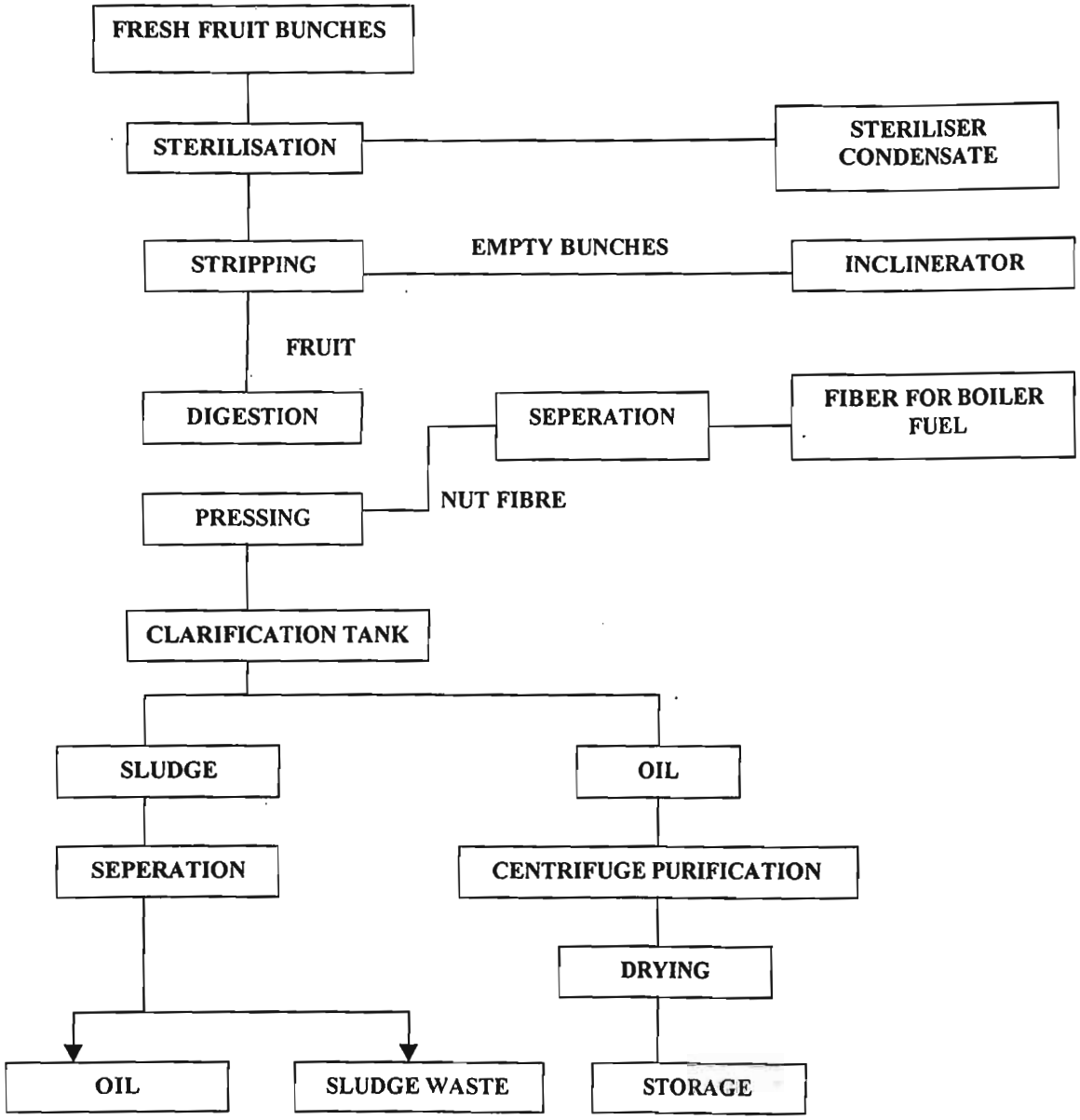
Oil purification and drying :

The oil from clarification tank still contains 0.4 to 0.6 per cent of water, 0.1 to 0.2 per cent of sludge and other impurities are removed by a high speed centrifuge with 800 rpm which can bring down the moisture level. Further reduction of moisture to the optimum level of 0.1 to 0.15 is achieved by vaccume drying. Finally the vaccume dried oil is pumped to storage tanks. This oil is called as crude palm oil (CPO) rich in Vitamin A and E.

Separation of nuts from fibre :

The pressed cake is passed through a steam jacketed screw conveyor, the nuts are separated by blowing off the lighter fibre in air stream with in a vertical cylinder. The nuts are cleaned and polished and fibre is conveyed to the boiler station.

Fig. 4.4 PALM OIL EXTRACTION



4.6.1 Costs and returns from oil palm processing :

4.6.1.1 Processing costs of one tonne of palm oil :

The processing costs including variable costs and fixed costs incurred in production of one tonne of palm oil by the oil mills were worked out and they are presented in Table 4.15.

It is evident from the table that the total costs incurred to produce one tonne of oil was Rs. 18,854.29. Of this the variable costs and fixed costs were Rs. 16,846.74 and Rs. 2,007.55 accounting for 89.35 and 10.65 per cent of the total costs respectively.

Among the variable costs, cost of raw material was the major item amounting to Rs. 16,176.47 and accounted for 85.80 per cent of the total costs per tonne of oil produced by the oil mills. Next to raw material, wages for casual labour formed the major item of variable costs which worked out to Rs. 380.88 (2.02 per cent), followed by incidental charges (0.81 per cent), fuel charges (0.31 per cent), power charges (0.21 per cent), miscellaneous charges (0.16 per cent), interest on working capital (0.03 per cent) and lubricant charges (0.01 per cent). The operations such as loading and unloading of raw material, separation of pulp from mesh, separation of oil from water, waste bunches disposal, fire wood shifting to boiler required more number of casual labour and hence more expenditure. Incidental charges were also led to more expenditure,

because of more usage of telephones and records. Fuel charges were higher than the power charges because of utilisation of generators.

Interest on fixed capital was the major item of fixed costs amounting to Rs. 1,092.37 per tonne of oil accounting for 5.79 per cent of the total costs. Next to interest on fixed capital, depreciation formed major item of expenditure in fixed costs which worked out to Rs. 620.9 (3.3 per cent). Salaries for permanent staff worked out to be Rs. 94.07 (0.50 per cent) per tonne of oil produced followed by taxes (0.40 per cent), repairs and maintenance (0.30 per cent), insurance charges (0.20 per cent) and opportunity cost of land (0.16 per cent).

4.6.1.2 Returns for one tonne of palm oil :

Returns obtained by the oil mill through the sale of one tonne of palm oil were worked out and presented in Table 4.15.

It is observed from the table that on an average palm oil mill crushed 5.88 tonnes fresh fruit bunches of oil palm to obtain one tonne of oil which is valued at Rs. 36,000 and 0.588 tonnes of kernals as by-product valued at Rs. 2,940. Thus the gross and net returns were worked out to be Rs. 38,940 and Rs. 20,086.01 per tonne of palm oil respectively.

Table 4.15 : Costs and returns from oil palm processing

(Rs. / tonnes)

Sl. No.	Particulars	Amount	Percentage
Variable costs			
1.	Cost of raw material	16176.47	85.80
2.	Incidental charges	153.66	0.81
3.	Wages for casual labour	380.88	2.02
4.	Power charges	38.60	0.21
5.	Lubricant charges	2.60	0.01
6.	Fuel charges	57.90	0.31
7.	Miscellaneous charges	30.94	0.16
8.	Interest on working capital	5.69	0.03
	Total variable costs	**16846.74**	**89.35**
Fixed costs			
1.	Depreciation on buildings		
	i. Factory building	174.67	0.93
	ii. Administrative building	30.19	0.16
	iii. Workshop	1.48	0.01
2.	Depreciation on		
	Machinery	327.95	1.74
	Effluent treatment plant	45.63	0.24
	Tractors & accessories	30.64	0.16
	Drums (205 lit capacity)	5.11	0.03
	Fire extinguishers & fixture	1.04	0.01
	Generators	4.19	0.02
3.	Opportunity cost of land	29.41	0.16
4.	Repairs and maintenance	57.44	0.30
5.	Insurance charges	38.65	0.20
6.	Taxes	74.71	0.40
7.	Salaries for permanent staff	94.07	0.50

8.	Interest on fixed capital	1092.37	5.79
	Total fixed costs	**2007.55**	**10.65**
	Total costs	**18854.29**	**100.00**
II	Returns		
	Returns from one tonne of oil	36,000	92.45
	Returns from kernels	2940	7.55
	Gross returns	38940	100.00
III	Net returns from one tonne of oil	20086.01	

4.7 PROBLEMS OF OIL PALM PRODUCTION AND PROCESSING :

An opinion survey was conducted to identify the problems faced by the farmers in the study area in cultivating oil palm and those faced by processing unit in processing oil palm.

4.7.1 Production problems :

The production problems faced by the oil palm growers were grouped as in the table 4.16 The particulars of the table revealed that cent percent of sample farmers felt that shortage of power for irrigating oil palm orchards was the major problem they are facing in cultivation of oil palm besides unremunerative prices for the product. Oil palm is a high water consuming crop requiring regular and adequate irrigation. But during the summer season power supply was highly erratic and inadequate. Due to this problem most of the farmers are afraid to take up oil palm in the absence of alternate source of power. The procurement price for tonne of oil palm fresh fruit bunches was fixed at Rs. 2,750 which in growers view is highly unremunerative and they felt that at least Rs. 3,000 should be the price of 1 tonne of oil palm fresh fruit bunches.

High input cost was quoted as a serious problem by 83.33 per cent of the farmers. The increase in the cost of inputs has inturn increased

the total cost of cultivation. Non-availability of high yielding varieties of oil palm was cited as a problem by 66.67 per cent of sample farmers.

Lack of adequate credit facilities coupled with lack of improved farm implements was quoted as a problem by 50 per cent of the farmers.

4.7.2 Processing Problems :

Non-availability of raw material (FFB) through out the year was the major problem faced by the processing unit which keep the unit idle for most part of the year which is highly uneconomical.

The second major problem expressed by the processing unit was the paucity of labour during peak periods.

Table 4.16 : Production problems of oil palm cultivation

Particulars	Farmers
Shortage of power supply	60 (100.00)
Lack of improved farm implements	30 (50.00)
Non-availability of high yielding varieties of oil palm	40 (66.67)
High input cost	50 (83.33)
Lack of adequate credit facilities	30 (50.00)
Price fluctuations	60 (100.00)

Note : Figures in parentheses indicate percentages to total farmers.

SUMMARY AND CONCLUSIONS

CHAPTER - V

SUMMARY AND CONCLUSIONS

Oil palm is recognised as the highest edible oil yielding crop which yields 4-6 tonnes of oil per tree for about 25 years of life and produces two distinct oils - palm oil and palm kernel oil that are used for culinary as well as for industrial purposes. Since 1950 the oil palm had been identified for growing in forest lands. In 1985 the committee consisting of Drs. K.V.A.Bavappa, P. Rethinam and K.U.K. Nampoothiri advised cultivation of the oil palm in command areas and garden lands as an irrigated crop. A year later the committee headed by the Rethinam identified 0.3 million ha suitable for oil plam cultivation in major command areas. In 1988 the central committee headed by K.L.Chada, Deputy Director General (Horticulture) consolidated 0.58 million ha in 9 states for cultivation of oil palm as an irrigated crop. With the addition of another 0.22 million hectares, the total potential area for growing oil palm is now stood at 0.80 million ha spread in 13 states.

Oil palm is highest oil yielding crop in the vegetable kingdom. The traditional oil seeds viz groundnut, mustard, safflower, sunflower, soybean, linseed etc. do not give more than 0.8 to 1.0 tonne of oil / ha / year. Coconut gives anything between 1.5 to 2.0 tonnes of oil / ha / year. As against these, oil palm has the potential to yield any where between 3 to 6 tonnes per ha / year of edible oil (Motilal 1996). Thus no

oil producing crop can ever compete with oil palm. At present India is importing palm oil as Palmolein to bridge the gap in production and consumption of oil. It is therefore necessary to go for cultivation of oil palm extensively. Besides, it can also contribute substantially to the nutritional and energy requirements of the masses. It is the crop of the future and a source of health and nutrition, enables diversification, import substitution, value addition, low cost of cultivation, waste utilisation and co-generation (non-conventional energy), besides being eco-friendly and sustainable (Dr.P.Rethinam, 1997). Farmers need to be informed about these benefits so as to increase the area under oil palm.

Even though oil palm is being cultivated in Nellore district since 1991, so far no research work has been undertaken on the economic aspects of oil palm production and processing.

The major focus of the present study is to make "Economic analysis of production and processing of oil palm in Nellore district of Andhra Pradesh" in the present context of increasing acreage under oil palm.

5.1 THE SPECIFIC OBJECTIVES OF THE STUDY ARE :

1. To work out costs and returns of oil palm orchards
2. To study the economic feasibility of oil palm orchards.
3. To estimate the costs and returns of oil palm processing and
4. To study the production and processing problems of oil palm.

Nellore district was purposively chosen for the study as it has considerable area under oil palm. All the mandals in Nellore district growing oil palm were arranged in descending order of the area under the crop and top 3 mandals were chosen purposively. Two villages from each selected mandal were chosen purposively using the above criterion making the number of sample villages to six. All the oil palm orchards in the selected villages were divided into two groups namely pre bearing orchards upto the age of 4 years and bearing orchards with the age above 4 years. An ultimate sample of 60 (30+30) oil palm growers covering the above two groups was chosen randomly based on multistage stratified sampling technique. The information pertaining to oil palm processing was collected from the lone processing unit located at Manubolu of Nellore district for the year 1998-99.

Tabular analysis was used to analyse the costs and returns of oil palm. Project appraisal techniques (NPW, B.C. ratio and IRR) were employed to test the economic feasibility of oil palm orchards. An opinion survey was conducted to study the production and processing problems of oil palm.

5.2 MAJOR FINDINGS OF THE STUDY :

The socio economic profile of selected growers revealed that the average size of the family was 7.23 members comprising of 2.86 males,

2.25 females and 2.12 children. The participation of family members in oil palm cultivation was less because majority of the oil palm orchardists belonged to well-to-do families.

The average size of holding was 7.32 hectares with 59.78 per cent of total area under oil palm cultivation. The average size of wet land was more (4.29 ha) than that of irrigated dry land (3.03 ha).

The per hectare value of assets stood at Rs. 1,65, 198.88. The land value formed 87.78 per cent of total value of farm assets. As regards, magnitude and pattern of non-land assets, the value of wells, machinery and implements and value of irrigation equipment occupied first, second and third places accounting for 4.06, 3.18 and 2.18 per cent of the total value of assets.

The total labour utilised for the establishment of oil palm orchard in the first year was 106.68 man days per hectare. Watch and ward required 15 man days (14.06 per cent) followed by fence and fence maintenance 14.62 man days (13.71 per cent), weeding 14.58 man days (13.67 per cent) digging of pits 14.29 man days (13.39 per cent) and ploughing, cleaning and levelling 12.55 man days (11.76 per cent) in the total human labour utilisation during 1st year.

About 58.09, 65.64 and 78.33 man days per hectare were required in 2nd, 3rd and 4th years respectively. During this period watch and ward and weeding, the most labour absorbing operations accounted for more than 45 per cent of total labour utilised followed by interculture (13 per cent).

In bearing period, human labour utilisation increased manifold. In the 5th year, the labour requirement was 78.75 man days which increased to 108.03 man days per hectare in 9th year and remained constant in the remaining years. Total labour utilisation during bearing period was about, 2,176.79 man days per hectare. A major share of 812.13 man days (37.31 per cent) was taken by harvesting followed by watch and ward with 421 man days (19.34 per cent) and weeding with 302.74 man days (13.91 per cent).

The total labour utilisation during economic life span (25 years) of oil palm orchard stood at 2,485.52 man days of which harvesting operation clubbed with watch and ward took 1,311.51 man days (52.76 per cent) followed by weeding and interculture 522.32 man days (21.01 per cent) and fencing and fence maintenance 156.28 man days (6.29 per cent).

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The plant population was maintained on par with the recommended plant population which is 143 plants per hectare. The total quantity of manures used during the economic life of the orchard was 181.39 tonnes per hectare. The use of N, P, K for the entire 25 years of economic life of oil palm orchard stood at 3,541.89, 1,976.13 and 3,722.67 kgs per hectare respectively. The orchardists also used 5,965.4 ml of plant protection chemicals.

The total costs per hectare of oil palm orchards during the pre-bearing period (1-4 years) were Rs. 77,899.64 of which Rs. 49,415.45 (63.43 per cent) were variable costs and Rs. 28,484.19 (36.57 per cent) fixed costs.

The total costs incurred to establish one hectare of oil palm orchard in 1st year stood at Rs. 27,536.34 compared to Rs. 15,946.26, Rs. 17,874.19 and Rs. 16,542.85 in 2nd, 3rd and 4th year respectively. Variable costs accounted for 73.08 per cent in the first year as against 53.17, 56.65 and 64.59 per cent of the total costs in 2nd, 3rd and 4th years respectively. The share of fixed costs was 26.92, 46.83, 43.35 and 35.41 per cent of the total costs for the corresponding years. During pre bearing period, rental value of owned land formed the major cost component accounting for 20.60 per cent in total costs followed by fertilisers (15.18 per cent), human labour (12.75 per cent) etc.

In bearing period from 5th to 9th year; the total costs per hectare increased from Rs. 19,687.31 in 5th year to Rs. 27,406.5 in 9th year and remained constant during the remaining period of life. The per hectare variable costs increased from Rs. 10,837.77 (55.05 per cent) during 5th year to Rs. 12,241.08 (44.66 per cent) during 9th year. The share of fixed costs in total costs increased from 44.95 per cent in the 5th year to 55.34 per cent in the 9th year of orchard due to steep rise in opportunity cost of owned land which was taken as 1/4th of gross produce obtained from orchard.

In bearing period, among operational costs, fertilizer cost formed major cost item with Rs. 83,184.24 (15.08 per cent) while rental value of owned land took lion's share with Rs. 2,33,564.76 (42.03 per cent) among fixed costs.

The net returns from intercrops during pre-bearing period helped to cushion the costs. The orchard started yielding from 3rd year onwards, though the economic yield coming only from 5th year onwards. The total yield for the entire economic life period was 403.64 tonnes per hectare.

The per hectare gross income increased from Rs. 22,038.50 in 5th year to Rs. 47,300 in 9th year. The range of net income was from Rs. 2350.69 in 5th year to Rs. 19,893.50 in 9th year. The yield, gross and net

incomes were increased during this period i.e from 5th to 9th year. They were assumed constant from 10th to 25th year.

The oil palm orchardists spent on an average Rs. 6,33,627.20 and Rs. 6,17,377.2 towards the cost of one hectare of oil palm during its life span of 25 years without and with subsidy respectively. The gross income realised by the oil palm orchardists during its life span amounted to Rs. 9,63,135.09 per hectare which included the net income from intercrops during its pre-bearing period and oil palm fresh fruit bunches from third year onwards. The respective net incomes received by the farmers without and with subsidy stood at Rs. 3,29,507.89 and Rs. 3,45,757.89.

Net present worth for the orchard was Rs. 65,201.48, Rs. 50,698.61, Rs. 3,96,45.43, Rs. 31,125.43, Rs. 24,540.44 Rs. 19,261.91, and Rs. 15,103.41 at 12, 14, 16, 18, 20, 22 and 24 per cent discount rates. Benefit cost ratios at the corresponding discount rates were 1.358, 1.321, 1.286, 1.253, 1.223, 1.193 and 1.166 respectively. The IRR was found to be 39.19 per cent indicating that investment on oil palm orchards is a profitable proposition.

The data to work out the cost of processing was obtained from the lone processing unit located at Manubolu, Nellore district. The total costs

incurred to produce one tonne of oil was Rs. 18,854.29. Of this the variable costs and fixed costs were Rs. 16,846.74 and Rs. 2,007.55 accounting for 89.35 and 10.65 per cent of the total costs respectively. Among the variable costs raw material was the major item amounting to Rs. 16,176.47 (85.80 per cent) of the total costs per tonne of oil produced by oil mills followed by casual labour charges (2.20 per cent). Interest on fixed capital was the major item of fixed costs amounting to Rs. 1,092.37 (5.79 per cent) per tonne of oil. The gross and net returns were worked out to Rs. 38,940 and Rs. 20,086.01 per tonne of palm oil respectively.

The major production problems of oil palm growers identified were shortage of power supply, price fluctuations and non-availability of high yielding oil palm varieties etc. The major processing problems expressed by processing unit were non-availability of raw material to run the unit throughout the year and paucity of labour during peak seasons.

5.3 CONCLUSIONS :

1. The total labour requirement for the cultivation of oil palm orchards during its economic life period was 2,485.52 man days per hectare.
2. Harvesting operation clubbed with watch and ward accounted for major share of total human labour requirement for entire economic

life span of oil palm orchard followed by weeding and interculture and fencing and fence maintenance.

3. Most of the farmers adopted the recommended package of practices.

4. Among the total costs during pre bearing period, operational costs occupied the major portion. Among total costs during pre-bearing period, rental value of owned land was the major cost item followed by fertilizer cost.

5. Among the total costs during bearing period, fixed costs occupied major portion than variable costs.

6. The total cost per hectare was Rs. 6,33,627.20 and Rs. 6,17,377.2 without and with subsidy respectively with a respective net income of Rs. 3,29,507.89 and Rs. 3,45,757.89 which included the income from intercrops.

7. Even at higher discount rate of 24 per cent, the oil palm cultivation was found economically viable.

8. The total processing costs incurred to produce one tonne of palm oil stood at Rs. 18,854.29 with a net income of Rs. 20,086.01 per tonne of palm oil produced.

9. The major production problems of oil palm identified were shortage of power supply and price fluctuations and the major processing problems were non-availability of raw material and paucity of labour during peak seasons.

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9. The major production problems of oil palm identified were shortage of power supply and price fluctuations and the major processing problems were non-availability of raw material and paucity of labour during peak seasons.

Suggestions :

Having set the ball in motion, there is scope for faster area expansion if the following activities are speeded up.

1. Considering the high yield per hectare, oil palm cultivation should be expanded to public sector and private sector.
2. Research on oil palm should be given necessary priority.
3. Delay in processing seed import has to be minimised. The respective state governments can be asked to import the seed directly after getting quarantine clearance.
4. To meet the target production of palm oil, an integrated approach is a must. Researchers, extension workers and policy makers have to work in coordination to improve the yield of this newly introduced crop.
5. The future expansion of oil palm cultivation in the country is likely to take place under irrigated conditions. The possibility of cultivating this crop under irrigated conditions, therefore needs to be systematically explored. This would involve determining irrigation requirements, defining best systems of irrigation and devising moisture conservation techniques.

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APPENDICES

Table 1 : Estimation of Benefit-cost Ratio at 12 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 12%	Present worth at costs	Present worth of gross returns
1	27536.34	19977.48	0.8929	24587.19	17837.89
2	15946.26	16507.24	0.7972	12712.36	13159.57
3	17874.19	18325.32	0.7118	12722.85	13043.96
4	16542.85	10065.00	0.6355	10512.98	6396.31
5	19687.81	22038.50	0.5674	11170.86	12504.64
6	21116.70	28435.04	0.5066	10697.72	14405.19
7	23730.19	37500.00	04523	10733.16	16961.25
8	25282.36	42187.50	0.4039	10211.55	17039.53
9	27406.49	47300.00	0.3606	9882.78	17056.38
10	27406.49	47300.00	0.3219	8822.15	15225.87
11	27406.49	47300.00	0.2875	7879.37	13598.75
12	27406.49	47300.00	0.2567	7035.25	12141.91
13	27406.49	47300.00	0.2292	6281.57	10841.16
14	27406.49	47300.00	0.2046	5607.37	9677.58
15	27406.49	47300.00	0.1827	5007.17	8641.71
16	27406.49	47300.00	0.1631	4469.99	7714.63
17	27406.49	47300.00	0.1456	3990.38	6886.88
18	27406.49	47300.00	0.1300	3562.84	6149.00
19	27406.49	47300.00	0.1161	3181.89	5491.53
20	27406.49	47300.00	0.1037	2842.05	4905.01
21	27406.49	47300.00	0.0926	2537.84	4379.98
22	27406.49	47300.00	0.0826	2263.78	3906.98
23	27406.49	47300.00	0.0738	2022.59	3490.74
24	27406.49	47300.00	0.0659	1806.09	3117.07
25	27406.49	47300.00	0.0588	1611.50	2781.24
				182153.28	247354.76

NPW = 65201.48
BCR = 1.357948

Table 2 : Estimation of Benefit-cost Ratio at 14 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 14%	Present worth at costs	Present worth of gross returns
1	27536.34	19977.48	0.8772	24154.88	17524.25
2	15946.26	16507.24	0.7695	12270.65	12702.32
3	17874.19	18325.32	0.6750	12065.08	12369.59
4	16542.85	10065.00	0.5921	9795.02	5959.49
5	19687.81	22038.50	0.5194	10225.85	11446.80
6	21116.70	28435.04	0.4556	9620.77	12955.00
7	23730.19	37500.00	0.3996	9482.58	14985.00
8	25282.36	42187.50	0.3506	8863.99	14790.94
9	27406.49	47300.00	0.3075	8427.49	14544.75
10	27406.49	47300.00	0.2697	7391.53	12756.81
11	27406.49	47300.00	0.2366	6484.38	11191.18
12	27406.49	47300.00	0.2076	5689.59	9819.48
13	27406.49	47300.00	0.1821	4990.72	8613.33
14	27406.49	47300.00	0.1597	4376.82	7553.81
15	27406.49	47300.00	0.1401	3839.65	6626.73
16	27406.49	47300.00	0.1229	3368.26	5813.17
17	27406.49	47300.00	0.1078	2954.42	5098.94
18	27406.49	47300.00	0.0946	2592.65	4474.58
19	27406.49	47300.00	0.0829	2271.99	3921.17
20	27406.49	47300.00	0.0728	1995.19	3443.44
21	27406.49	47300.00	0.0638	1748.53	3017.74
22	27406.49	47300.00	0.0560	1534.76	2648.80
23	27406.49	47300.00	0.0491	1345.66	2322.43
24	27406.49	47300.00	0.0431	1181.22	2038.63
25	27406.49	47300.00	0.0378	1035.97	1787.94
Total	**635182.00**	**999136.00**		**157707.69**	**208406.30**

NPW = 50698.61
BCR = 1.32147

Table 3 : Estimation of Benefit-cost Ratio at 16 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 16%	Present worth at costs	Present worth of gross returns
1	27536.34	19977.48	0.8621	23739.08	17222.59
2	15946.26	16507.24	0.7432	11851.26	12268.18
3	17874.19	18325.32	0.6407	11451.99	11741.03
4	16542.85	10065.00	0.5523	9136.62	5558.90
5	19687.81	22038.50	0.4761	9373.37	10492.53
6	21116.70	28435.04	0.4104	8666.29	11669.74
7	23730.19	37500.00	0.3538	8395.74	13267.50
8	25282.36	42187.50	0.3050	7711.12	12867.19
9	27406.49	47300.00	0.2630	7207.91	12439.90
10	27406.49	47300.00	0.2267	6213.05	10722.91
11	27406.49	47300.00	0.1954	5355.23	9242.42
12	27406.49	47300.00	0.1685	4617.99	7970.05
13	27406.49	47300.00	0.1452	3979.42	6867.96
14	27406.49	47300.00	0.1252	3431.29	5921.96
15	27406.49	47300.00	0.1079	2957.16	5103.67
16	27406.49	47300.00	0.0930	2548.80	4398.90
17	27406.49	47300.00	0.0802	2198.00	3793.46
18	27406.49	47300.00	0.0691	1893.79	3268.43
19	27406.49	47300.00	0.0596	1633.43	2819.08
20	27406.49	47300.00	0.0514	1408.69	2431.22
21	27406.49	47300.00	0.0443	1214.11	2095.39
22	27406.49	47300.00	0.0382	1046.93	1806.86
23	27406.49	47300.00	0.0329	901.67	1556.17
24	27406.49	47300.00	0.0284	778.34	1343.32
25	27406.49	47300.00	0.0245	671.46	1158.85
Total	**635182.00**	**999136.00**		**138382.77**	**178028.2**

NPW = 39645.43
BCR = 1.28649

Table 4 : Estimation of Benefit-cost Ratio at 18 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 18%	Present worth at costs	Present worth of gross returns
1	27536.34	19997.48	0.8475	23337.05	16930.91
2	15946.26	16507.24	0.7182	11452.60	11855.50
3	17874.19	18325.32	0.6086	10878.23	11152.79
4	16542.85	10065.00	0.5158	8532.80	5191.53
5	19687.81	22038.50	0.4371	8605.54	9633.03
6	21116.70	28435.04	0.3704	7821.63	10532.34
7	23730.19	37500.00	0.3139	7448.91	11771.25
8	25282.36	42187.50	0.2660	6725.11	11221.88
9	27406.49	47300.00	0.2255	6180.16	10666.15
10	27406.49	47300.00	0.1911	5237.38	9039.03
11	27406.49	47300.00	0.1619	4437.11	7657.87
12	27406.49	47300.00	0.1372	3760.17	6489.56
13	27406.49	47300.00	0.1163	3187.38	5500.99
14	27406.49	47300.00	0.0985	2699.54	4659.05
15	27406.49	47300.00	0.0835	2288.44	3949.55
16	27406.49	47300.00	0.0708	1940.38	3348.84
17	27406.49	47300.00	0.0600	1644.39	2838.00
18	27406.49	47300.00	0.0508	1392.25	2402.84
19	27406.49	47300.00	0.0431	1181.22	2038.63
20	27406.49	47300.00	0.0365	1000.34	1726.45
21	27406.49	47300.00	0.0309	846.86	1461.57
22	27406.49	47300.00	0.0262	718.05	1239.26
23	27406.49	47300.00	0.0222	608.42	1050.06
24	27406.49	47300.00	0.0188	515.24	889.24
25	27406.49	47300.00	0.0160	438.50	756.80
Total	**635182.00**	**999136.00**		**122877.67**	**154003.10**

NPW = 31125.43
BCR = 1.253304

Table 5 : Estimation of Benefit-cost Ratio at 20 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 20%	Present worth at costs	Present worth of gross returns
1	27536.34	19977.48	0.8333	22946.03	16647.23
2	15946.26	16507.24	0.6944	11073.08	11462.63
3	17874.19	18325.32	0.5787	10343.79	10604.86
4	16542.85	10065.00	0.4832	7993.51	4863.41
5	19687.81	22038.50	0.4019	7912.53	8857.27
6	21116.70	28435.04	0.3349	7017.98	9522.89
7	23730.19	37500.00	0.2791	6623.09	10466.25
8	25282.36	42187.50	0.2326	5880.68	9812.81
9	27406.49	47300.00	0.1938	5311.38	9166.74
10	27406.49	47300.00	0.1615	4426.15	7638.95
11	27406.49	47300.00	0.1346	3688.91	6366.58
12	27406.49	47300.00	0.1122	3075.01	5307.06
13	27406.49	47300.00	0.0935	2562.51	4422.55
14	27406.49	47300.00	0.0779	2134.97	3684.67
15	27406.49	47300.00	0.0649	1778.68	3069.77
16	27406.49	47300.00	0.0541	1482.69	2558.93
17	27406.49	47300.00	0.0451	1236.03	2133.23
18	27406.49	47300.00	0.0376	1030.48	1778.48
19	27406.49	47300.00	0.0313	857.82	1480.49
20	27406.49	47300.00	0.0261	715.31	1234.53
21	27406.49	47300.00	0.0217	594.72	1026.41
22	27406.49	47300.00	0.0181	496.06	856.13
23	27406.49	47300.00	0.0151	413.84	714.23
24	27406.49	47300.00	0.0126	345.32	595.98
25	27406.49	47300.00	0.0105	287.77	496.65
Total				110228.34	134768.78

NPW = 24540.44
BCR = 1.22263

Table 6 : Estimation of Benefit-cost Ratio at 22 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 22%	Present worth at costs	Present worth of gross returns
1	27536.34	19977.48	0.8197	22571.54	16375.54
2	15946.26	16507.24	0.6719	10714.29	11091.21
3	17874.19	18325.32	0.5507	9843.32	10091.75
4	16542.85	10065.00	0.4514	7467.44	4543.34
5	19687.81	22038.50	0.3700	7284.49	8154.24
6	21116.70	28435.04	0.3033	6404.69	8624.35
7	23730.19	37500.00	0.2486	5899.33	9322.50
8	25282.36	42187.50	0.2038	5152.55	8597.81
9	27406.49	47300.00	0.1670	4576.88	7899.10
10	27406.49	47300.00	0.1369	3751.95	6475.37
11	27406.49	47300.00	0.1122	3075.01	5307.06
12	27406.49	47300.00	0.0920	2521.39	4351.60
13	27406.49	47300.00	0.0754	2066.45	3566.42
14	27406.49	47300.00	0.0618	1693.72	2923.14
15	27406.49	47300.00	0.0507	1389.51	2398.11
16	27406.49	47300.00	0.0415	1137.37	1962.95
17	27406.49	47300.00	0.0340	931.82	1608.20
18	27406.49	47300.00	0.0279	764.64	1319.67
19	27406.49	47300.00	0.0229	627.61	1083.17
20	27406.49	47300.00	0.0187	512.50	884.51
21	27406.49	47300.00	0.0154	422.06	728.42
22	27406.49	47300.00	0.0126	345.32	595.98
23	27406.49	47300.00	0.0103	282.29	487.19
24	27406.49	47300.00	0.0085	232.96	402.05
25	27406.49	47300.00	0.0069	189.10	326.37
Total				**99858.19**	**119120.10**

NPW =19261.91
BCR = 1.19289

Table 7 : Estimation of Benefit-cost Ratio at 24 per cent discount rate

(Rs/ha)

Year	Costs	Gross returns	Discount factors at 24%	Present worth at costs	Present worth of gross returns
1	27536.34	19977.48	0.8065	22208.06	16111.84
2	15946.26	16507.24	0.6504	10371.45	10736.31
3	17874.19	18325.32	0.5245	9375.01	9611.63
4	16542.85	10065.00	0.4230	6997.63	4257.49
5	19687.81	22038.50	0.3411	6715.51	7517.33
6	21116.70	28435.04	0.2751	5809.20	7822.48
7	23730.19	37500.00	0.2218	5263.36	8317.50
8	25282.36	42187.50	0.1789	4523.01	7547.34
9	27406.49	47300.00	0.1443	3954.76	6825.39
10	27406.49	47300.00	0.1164	3190.12	5505.72
11	27406.49	47300.00	0.0938	2570.73	4436.74
12	27406.49	47300.00	0.0757	2074.67	3580.61
13	27406.49	47300.00	0.0610	1671.79	2885.30
14	27406.49	47300.00	0.0492	1348.39	2327.16
15	27406.49	47300.00	0.0397	1088.04	1877.81
16	27406.49	47300.00	0.0320	877.01	1513.60
17	27406.49	47300.00	0.0258	707.09	1220.34
18	27406.49	47300.00	0.0208	570.06	983.84
19	27406.49	47300.00	0.0168	460.43	794.64
20	27406.49	47300.00	0.0135	369.99	638.55
21	27406.49	47300.00	0.0109	298.73	515.57
22	27406.49	47300.00	0.0088	241.18	416.24
23	27406.49	47300.00	0.0071	194.59	335.83
24	27406.49	47300.00	0.0057	156.22	269.61
25	27406.49	47300.00	0.0046	126.07	217.58
Total				**91163.09**	**106266.50**

NPW = 15103.41
BCR = 1.16567

Table 8 : Estimation of Internal Rate of Return

(Rs/ha)

Year	Net Returns (Rs)	Discount factors (35%)	Discounted net returns at 35%	Discount factors (40%)	Discounted net returns at 40%
1	-7558.86	0.7407	-5598.85	0.71428	-6509.74
2	560.98	0.548696	307.81	0.510204	286.21
3	451.13	0.406422	183.36	0.364431	164.41
4	-6477.85	0.301068	-1950.27	0.260308	-1686.24
5	2350.69	0.223013	524.23	0.185934	437.07
6	7318.34	0.165195	1280.95	0.132810	971.95
7	13769.81	0.122366	1684.96	0.094865	1306.27
8	16905.14	0.090642	1532.32	0.067776	1145.49
9	19893.51	0.067142	1335.69	0.048400	962.85
10	19893.51	0.049735	989.40	0.034572	687.76
11	19893.51	0.036840	732.88	0.024694	491.25
12	19893.51	0.027289	542.87	0.017638	350.88
13	19893.51	0.020214	402.13	0.012599	250.64
14	19893.51	0.014973	297.87	0.008999	179.02
15	19893.51	0.011091	220.64	0.006428	127.88
16	19893.51	0.008216	163.45	0.004591	91.33
17	19893.51	0.006086	121.07	0.003280	65.25
18	19893.51	0.004508	89.68	0.002343	46.61
19	19893.51	0.003339	66.42	0.001673	33.28
20	19893.51	0.002474	49.22	0.001195	23.77
21	19893.51	0.001832	36.44	0.000854	16.98
22	19893.51	0.001357	26.99	0.000610	12.14
23	19893.51	0.001005	19.99	0.000436	8.67
24	19893.51	0.000745	14.82	0.000311	6.19
25	19893.51	0.000552	10.98	0.000222	4.42
Total			2700.96		-525.65

IRR = 39.185445