IMPACT OF COMMAND AREA DEVELOPMENT AUTHORITY (CADA) : AN ECONOMIC ANALYSIS OF NEYYAR IRRIGATION PROJECT

ASWATHY VIJAYAN

THESIS

submitted in partial fulfilment of the requirement for the degree of

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Faculty of Agriculture
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Department of Agricultural Economics

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DECLARATION

I hereby declare that the thesis entitled "Impact of Command Area Development Authority (CADA): An Economic Analysis of Neyyar Irrigation Project" is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellanikkara
30.12.04

Aswathy Vijayan

CERTIFICATE

Certified that the thesis entitled **"Impact of Command Area Development Authority (CADA): An Economic Analysis of Neyyar Irrigation Project"** is a record of research work done independently by **Miss Aswathy Vijayan** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associateship or fellowship to her.

Vellanikkara

Dr. Sathees Babu.K

(Major Advisor, Advisory Committee)
Assistant Professor (Sr. Scale),
Department of Agricultural Economics,
College of Horticulture,
Vellanikkara.

CERTIFICATE

We, the undersigned members of the advisory committee of **Miss. Aswathy Vijayan,** a candidate for the degree of **Master of Science in Agriculture**, with major field in Agricultural Economics, agree that the thesis entitled **"Impact of Command Area Development Authority (CADA): An Economic Analysis of Neyyar Irrigation Project"** may be submitted by Miss Aswathy Vijayan, in partial fulfilment of the requirement for the degree.

Dr. Sathees Babu.K, 22/12/04

(Chair Person Advisory Committe)
Assistant Professor (Sr. Scale),
Department of Agricultural Economics,
College of Horticulture, Vellanikkara

Dr. E. K. Thomas 22.12.04

(Member, Advisory Committee)
Associate Professor and Head
Department of Agricultural Economics
College of Horticulture
Vellanikkara

22/12/04

Dr.V.K.G.Unnithan,

(Member, Advisory Committee)
Associate Professor and Head,
Department of Agricultural Statistics,
College of Horticulture,
Vellanikkara

22/12/04

Dr.C.George Thomas,

(Member, Advisory Committee)
Associate Professor,
Department of Agronomy,
College of Horticulture,
Vellanikkara.

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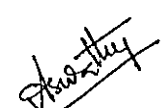

AswathyVijayan

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LIST OF ABBREVIATIONS

Sl No	Abbreviations	Expansion
1	%	Per Cent
2	()	Parentheses
3	/	Per
4	BCR	Benefit Cost Ratio
5	BFA	Beneficiary Farmers Association
6	CADA	Command Area Development Authority
7	CI	Capital Investment
8	CIF	Cash Inflow
9	COF	Cash Outflow
10	CWRDM	Centre for Water Resources Development and Management
11	DF	Discount Factor
12	ECIF	Economic Cash Inflow
13	ECOF	Economic Cash Out flow
14	ERR	Economic Rate of Returns
15	FRL	Full Reservoir Level
16	FRR	Financial Rate Returns
17	FYP	Five Year Plan
18	GOI	Government of India
19	GOK	Government of Kerala
20	ha	Hectare
21	IRR	Internal Rate of Returns
22	Kg	Kilo Gram
23	LBC	Left Bank Canal
24	NIP	Neyyar Irrigation Project
25	NPV	Net Present Value
26	O&M	Operation and Maintenance
27	PBP	Pay Back Period
28	PIM	Participatory Irrigation Management
29	ppc	Plant protection chemicals
30	RBC	Right Bank Canal
31	RBYI	Rainfed Based Yield Index
32	Rs	Rupees
33	Std	Standard
34	VFPCK	Vegetable and Fruit Promotion Council Keralam

Affectionately dedicated to my papa and amma

Introduction

CHAPTER I

INTRODUCTION

Irrigation projects the world over has experienced wide divergence between respective irrigation potential created and their utilization. Earlier projects, referred to as "first generation of projects" used to undertake only construction of storage reservoirs, dams as well as network of canals to take water to the outlet, leaving the responsibility of construction and maintenance of field channels and watercourses necessary for taking water to the agricultural lands with the beneficiary farmers (Joseph, 2001). Hence, the "second generation of projects" launched in the mid-seventies followed a more integrated and comprehensive approach. The water resource policy, in the meanwhile, underwent tremendous changes. The focus of the new policy shifted from investment in physical structures to improved management, conservation and institutional changes (Government of Kerala, 2004b). More autonomy was provided to the states in planning, execution and management of irrigation projects with the active involvement of the beneficiaries at every level. Water is increasingly being recognized as a precious and finite resource that must be used more judiciously.

1.1.IRRIGATION POLICY IN INDIA

Water resources, as an input to agriculture, have become vital in economic growth and sustainable development. Its catalytic role in enhancing productivity to meet food and income needs of Indian economy is well documented (FAO, 1971; Government of India, 1976; Dhawan, 1999; Selvarajan *et al.*, 2001). When the era of planning began in 1951, planners in India were quick to realise the strategic importance of irrigation as a key to increasing agricultural production. As a result, irrigation projects received top priority for agricultural development. Outlay of irrigation formed about 23 per cent of the total plan expenditure during the First Five Year Plan. The earliest irrigation policy tried to encompass increased production of food grain and protection of the vulnerable areas against

the vagaries of rainfall by bringing irrigation to more drought affected areas (Government of India, 1972). Later, the emphasis shifted to maximum production per unit water and higher conjunctive uses of surface as well as ground water (Government of India, 1976).

The growing concern at the wide gap between the irrigation potential created and the utilisation led the Government of India to evolve a comprehensive irrigation development programme for every major irrigation projects in the country for co-ordinating the activities of various agencies involved in area development. Accordingly, Command Area Development Authority (CADA) was launched in the country with the emphasis on integrated management, conservation of soil energy and biological resource. However, CADA was also not free from shortcomings. Its main shortcomings were slow progress of field channel construction mainly due to inadequate funding by state governments; poor maintenance and upkeep of canal and failure of proper enforcement of *Warabhandhi*, a system of rotational water distribution. Therefore, CADA is being restructured during Tenth Plan (2002-2007) to improve existing condition of water availability and make the stakeholders responsible for operation and upkeep of the down stream systems. (Government of India, 2003). "Participatory Irrigation Management"(PIM) is an attempt to increase farmer's direct involvement in irrigation management, which was previously looked after by government. It changes the government's role to facilitator with the objective of enabling farmer better access to water.

1.2. IRRIGATION STATUS IN KERALA

The agricultural sector in Kerala accounts for 71 per cent of the annual fresh water withdrawal. This is followed by the domestic and industrial demand (Table 1.1). This is in contrast to the all India pattern, where 92 per cent of the water is consumed by the agricultural sector. It is mainly on account of the less

water demanding perennial crops dominating the cropping pattern in lieu of seasonal and water demanding food crops (Government of Kerala, 2004b).

Table1.1 Purpose wise annual fresh water withdrawals

Sl. No.	Country/region	Sectors		
		Agriculture (%)	Industry (%)	Domestic (%)
1.	World	71.00	20.00	10.00
2.	India	92.00	3.00	4.00
3.	Kerala	71.00	11.00	18.00

Source: Government of Kerala, 2004b

There is a popular perception that Kerala is receiving heavy rainfall, and hence irrigation is not important. The fact is that about 90 per cent of the annual rainfall is received during a few months from June to August and October to November. It means, the remaining period from December to May is practically dry. This uneven distribution of rainfall causes damages to crops by floods during monsoon and by drought during summer months. Hence irrigation is a must for crops in Kerala for successful cultivation (Government of Kerala, 1974).

The net irrigated area in the State was 3.33 lakh hectares during 1990-91, which increased to 3.93 lakh hectares by 2002- 03. However, the gross irrigated area, as a percentage of the total cropped area remained almost stagnant around 13 to 15 per cent during the same period (Table 1.2).

Table1.2. Source wise net irrigated area in Kerala

('000ha)

Sl. No.	Source	Year				
		1990-91	1995-96	2000-01	2001-02	2002-03*
1	Canals	107.96 (32.38)	106.82 (31.22)	104.97 (27.55)	99.68 (28.75)	105.41 (26.81)
2	Tanks	48.95 (14.68)	49.21 (14.38)	49.97 (13.11)	49.95 (14.41)	66.73 (16.97)
3	Wells	65.68 (19.70)	73.14 (21.37)	115.7 (30.36)	86.3 (24.89)	117.49 (29.88)
4	Other sources	110.78 (33.23)	113.03 (33.03)	110.4 (28.98)	110.79) (31.95)	103.54 (26.33)
5	Total	333.37 (100.00)	342.19 (100.00)	381.04 (100.00)	346.72 (100.00)	393.17 (100.00)
6	Gross irrigated area	384.65	465.5	457.87	432.22	447.49
7	Gross irrigated area as percent of gross cropped area	12.74	15.18	15.15	14.44	14.77

*Provisional
Figures in parenthesis represent percent to the respective totals
Source: Government of Kerala, 2004

The major source of irrigation in the state is wells in 2002-03. Its share has been increasing from about 20 per cent in 1990-91 to nearly 30 per cent in 2002-03(Table 1.2). Canals have been the second most source of irrigation in the state. Their share during the corresponding period declined from 32 per cent to 27 per cent. Thus there is a slow shift in the source of irrigation from canals to wells. Though canal is a public irrigation system the uncertainties regarding quantity and timing of water release compel farmers to seek alternative irrigation sources that are reliable and there fore less risky. That is why well irrigation is on the increase in spite of heavy initial investments to be made.

A major crop receiving irrigation in Kerala is paddy. It accounts for around 41 per cent of irrigated area. This is followed by coconut, banana, and vegetables in that order (Table 1.3).

Table 1.3. Crop wise gross irrigated area

('000ha)

Sl.No.	Crops	1990-91	1995-96	2000-01	2001-02	2002-03
1	Paddy	225.06 (58.52)	234.41 (50.36)	208.05 (45.44)	183.99 (42.60)	183.7 (41.06)
2	Tubers	0.89 (0.23)	0.95 (0.2)	0.98 (0.21)	0.97 (0.22)	1.01 (0.23)
3	Vegetables	5.77 (1.50)	7.43 (1.6)	8.53 (1.86)	8.97 (2.08)	9.79 (2.19)
4	Coconut	104.89 (27.27)	164.52 (1.50)	165.96 (36.25)	158.05 (36.6)	163.55 (36.55)
5	Arecanut	20.21 (5.26)	25.54 (5.49)	30.50 (6.06)	31.47 (7.29)	34.21 (7.65)
6	Spices & condiment	2.19 (0.57)	4.4 (0.95)	5.54 (1.21)	5.28 (1.22)	6.16 (1.38)
7	Banana	10.56 (2.75)	10.74 (2.31)	19.45 (4.25)	14.37 (5.64)	29.21 (6.53)
8	Betel Vine	0.91 (0.24)	.93 (0.2)	0.99 (0.22)	.94 (0.22)	0.99 (0.22)
9	Sugar cane	2.18 (0.57)	3.84 (0.82)	3.37 (0.74)	3.27 (0.76)	3.43 (0.77)
10	Others	11.92 (3.10)	12.74 (2.74)	14.51 (3.17)	14.57 (3.37)	15.37 (3.44)
11	Total	384.56 (100)	465.5 (100)	457.87 (100)	431.88 (100)	447.49 (100)

*Provisional
Figures in parenthesis represent percent to the respective totals
Source: Government of Kerala, 2004b

CADA was constituted in Kerala in 1985. The activities of CADA were brought under the purview of the Kerala Command Area Development Act during the year 1986. All the completed irrigation projects were handed over to CADA since the Fifth Five Year Plan onwards. In spite of these efforts, there were wide spread under utilization of created irrigated potential in the state (Government of Kerala, 1996b).

Even though CADA had the mandate to involve farmers in the management of irrigation systems below outlets, where from water is released to fields, a formal Participatory Irrigation Management (PIM) system was not in vogue. Government of Kerala (GOK) is planning to implement PIM in selected projects as part of the Tenth Plan strategy, and the Neyyar and Malampuzha irrigation projects have been

selected on a pilot basis. It is against this background the study is making an attempt to evaluate the impact of Neyyar irrigation project on the socio- economic well being of the beneficiary farmers in the command area.

1.3.OBJECTIVES OF THE STUDY

The present study entitled " Impact of Command Area Development Authority (CADA): An Economic Analysis of Neyyar Irrigation Project" is undertaken with the following specific objectives.

1.To evaluate the socio economic impact of Neyyar Irrigation Project in the command area, and

2. To identify the operational problems

1.4.LIMITATIONS OF THE STUDY

No human effort is free from limitations. This study is no exception. The method of data collection employed was survey method. Most farmers, except a few, did not maintain any farm records. Hence, the objectivity of the data is limited to the extent the respondents were able to recollect from memory without recall bias. However, every effort was made to minimize the error by cross checking the information provided.

1.5.ORGANISATION OF THE THESIS

Besides the introductory chapter, the study is organized into five chapters. Chapter two is a review of literature relevant to the study. Chapter three describes the profile of the study area, the methodological framework, analytical tools, and conceptual issues. The results of the study and the discussion of the findings are presented in chapter four. The fifth chapter summarizes the main findings and conclusions drawn from analysis, along with policy implications.

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

This chapter presents a comprehensive review of past works relevant to the present study. An attempt has been made to throw light on the present status, strengths and weakness of the existing studies on the topic, from the point of view of methodology as well as relevance. The review of literature is categorized into the following sections:

2.1. Impact of irrigation

2.2. Economic analysis of irrigation projects

2.3. Operational aspects of irrigation projects

2.4. Water policy in India

2.1 IMPACT OF IRRIGATION

Government of Maharashtra (1962) observed that the variation in the magnitude and period of availability of irrigation water had considerable effect on the yield of crops .In the case of perennial crops, the difference was appreciable. This is mainly because of the reason that seasonal crops are receiving water even from sources, which have supply only for a limited period.

An evaluation by Government of Kerala (1967) revealed that in the command area of Malampuzha irrigation project there was an increase in production of rice. The main reason for this increase in yield is that the project provided the incentives for the use of improved seeds, manures and fertilizers. The number of sowings per year had increased and so the gross irrigated area. Provision of assured water supply had not only brought about an increase in the gross cultivated area, but also helped to stabilize the area.

Narayana and Nair (1983) reported that the impact of irrigation in terms of stabilizing productivity of paddy lands was only marginal in Kerala. Irrigation lacked significant influence on crop yield. This was due to poor management of irrigation water

Mitra (1984) studied the Mula irrigation project in Maharashtra and emphasized the need for laying stress in economic efficiency in planning; implementation and management of irrigation projects so that more project benefits accrued to the farmers. According to him, there had been substantial change in the productivity of major cereals, specifically paddy, under various projects in India. The study concluded that there was a high return to investment on farm development works taken under the Command Area Development programme in India.

According to Dhawan (1985) the intensity of cropping increased in full harmony with the rise in percent irrigated area over time in India. One percent increase in irrigated area was accompanied by one percent rise in intensity of cropping. Irrigation led to double cropping of farmland in a single year with irrigation provisions. Higher yield in irrigated area as compared to yield in non-irrigated areas showed a positive yield contribution by irrigation.

Udayakumar (1986) studied the changes in cropping intensity associated with area irrigated in Tamil Nadu. The study revealed that during the last three decades, Tamil Nadu witnessed significant changes in cropping pattern with a decline in the importance of coarse grains, pulses and oil seeds in the cropping pattern. The shift has been towards crops using more water or crops, which were dependent on the assured supply of water. Paddy had gained area since 1950s at the expense of coarse cereals. Other minor but water intensive and relatively long duration crops like banana, sugar cane, chillies, and other food crops had gained area. The analysis showed that three factors, *viz.*, the total rainfall, level of irrigation and intensity of irrigation largely accounted for variation in the cropping

pattern. The study underlined the role of irrigation in bringing about a shift in area from low value crops to high value crops, short duration to long duration crops and from less water intensive to more water intensive crops.

Pawar (1989) in a study on relationship between irrigation and agriculture in Upper Krishna basin observed that use of mechanical and biochemical inputs had increased in irrigation tracts. Adoption of tractor had increased to a considerable extent, which was commensurate with the extent of irrigation facilities. Significant correlation was noted in the case of biological inputs like fertilizers, pesticides, high yielding varieties and irrigated area .Use of such inputs was insignificant in areas where seasonal and non-assured nature of water supply prevailed.

According to Dinkar (1990), irrigation was the single main aspect, which could increase the crop production with a greater impact. The average yield under major crops in *Kharif* and *Rabi* was much higher as compared to the rainfed situation. For farmers, to have optimum utilization of water, assured irrigation water supply is very important. For this, farmers should be intimated well in advance about the date and frequency of water to be released. Once the dates have been notified, *Warabandhi* schedules must be prepared and they must be adhered to instill confidence in future also.

Shrivastva *et al.* (1991) studied the land use pattern of land resource in Tawa command area and reported that the immediate effect of the canal water was an increase in the net sown area. Gross sown area also increased due to double cropping. Area under gram, pea, lentil, linseed and sugar cane revealed an increasing tendency during post project period .The shift in non-food crops was positive over time after availability of Tawa irrigation.

Vaidyanadhan *et al* (1994) analyzed the impact of irrigation in agriculture and reported that the cropping pattern in irrigated areas in Tamil Nadu was

different from that of the rainfed area. The irrigated lands were used more intensively through out the year than unirrigated land. The yield of particular crop per unit area was also invariably higher under irrigation.

Government of Kerala (1996a) evaluated the impact of Command Area Development Programme on the production and productivity of important crops in the command of 10 irrigation projects under CADA in Kerala, which included Neyyar Irrigation Project also. It was found that there was wide gap between irrigation potential created and utilized. The productivity of paddy in the Chalakkudy, Vazhani and Peechi project area were lower than corresponding average productivity for the district. This was more pronounced for the winter and summer crop than the autumn crop, when water scarcity is more severely felt. The productivity of banana crop in the command area was lower to the corresponding average productivity in the district for most projects. No satisfactory explanation is given for this disturbing trend.

Vekariya (1997) in his study on differential impact of irrigation projects on farmers of South Saurashtra zone revealed that there existed differences in the cropping pattern and gross cropped area between beneficiaries of command area and non-beneficiaries. A reduction in unit cost of production was also noticed in the beneficiary group. Positive impact of irrigation project on yields and net income from both *Kharif* and *Rabi* crops were observed.

According to Azam (1998), irrigation had got a good role in raising the intensity of cropping. It had also got beneficial role in bringing stability to crop output. Irrigation was a prerequisite to the use of high yielding variety seeds and chemical fertilizers. Provision of irrigation facilities and other inputs provide an opportunity to use the available land intensively. With the development of irrigation, the gross cropped area could increase. Irrigation was a catalytic factor, which determine the use of other inputs like fertilisers, and high yielding varieties.

Economic evaluation of irrigation is important because irrigation is a highly capital using activity. The estimates for the period from 1980-81 to 1992-93 showed that the yield gain in India from utilizing canal water increased from Rs.2563 per hectare in 1980-81 to Rs.7924 per hectare in 1992-93. This was achieved at a resource cost of supplying irrigation water at Rs.2277 per crop hectare, indicating that economic gains from irrigation have been substantial in India (Dhawan, 1999).

Karunakaran and Palaniswamy (1998) analyzed the impact of irrigation sources on cropping intensity in Tamil Nadu. The results revealed definite evidence of close relationship between irrigation development and intensity of cropping at the state level in Tamil Nadu. The minor irrigation (tube and dug well) showed more impact on intensity of cropping. Hence, they called for more investment for minor irrigation in the subsequent plans in Tamil Nadu, especially in view of the fact that minor irrigation required lower investment per hectare basis than major and medium irrigation projects.

Mollinga (1998) observed that all the farmers in the Tungabadhra canal in Raichur district of Karanataka used high yielding varieties for all the crops under irrigated condition. Irrigation led to a shift in cropping pattern to high input- high output, and high value cropping pattern. The yield of rice and irrigated sorghum were several times higher than that of rainfed crops. There was difference in the labour use pattern. Irrigated farming was not only more labour intensive but also relied more on hired labor.

Regmi *et al.* (2000) revealed that the major crops grown under irrigated conditions contribute to a higher level of crop productivity and net income than those in the rain fed conditions. Irrigation had a positive impact on crop diversification and commercialization of agriculture in Nepal. Farmers having irrigation and market facilities were found to shift from traditional cereal

production to commercial vegetable production.

Sivasubramaniyan (2000) reported that the of irrigation had resulted in shift in cropping pattern over dry or less water intensive cropping pattern to irrigated high value crops, increase in cropping intensity and a considerable improvement in the productivity of crops.

Narayanamoorthy (2001) reported the production augmenting and wage enhancing effects of irrigation. The development of irrigation increased the intensity of cultivation, which in turn increased the demand for agricultural labour. The intensive cultivation increased the production of agricultural commodity, and as a result the prices of essential commodity go down. Thus, the real wages of agricultural labourers increased

Hussain *et al.* (2003) analysed the impact of conjunctive use of canal water and ground water in wheat productivity and profitability in India and Pakistan. The highest yield was obtained with exclusive canal water use and yields are the lowest with the exclusive ground water use. Overall aggregate yield increases with decreasing use of poor quality irrigation water. The highest gross margin was achieved in all the reaches reflecting the combined positive effects of higher yields and lower cost of production mainly because of the low cost of canal water.

2.2 ECONOMIC ANALYSIS OF IRRIGATION PROJECTS

All the irrigation projects during the pre-independence era were tested for their financial viability by considering the capital cost of the work on the sum actually spent on their construction, and debiting the revenue account annually with simple interest on capital cost of the works at the commencement of the year along with the working expenses for the year. The revenue account, on the other hand, was credited with annual direct and indirect receipts. The required percent

of return from irrigation in investment was also arbitrarily reckoned in the range 3.75 to 6 per cent annually. In 1964, the " Committee to Suggest Ways and Means of Improving Financial Returns from Irrigation Projects" recommended the economic benefits criteria for evaluation of irrigation projects. The Government of India (GOI) accepted this recommendation and a benefit cost ratio criteria has since been used (Government of India, 1972). A benefit cost ratio of 1.50 was used as a cut off rate.

However, limitations of the above approach was well known and the need for more refined approaches were expressed widely (Leven,1970; Gittinger, 1972; Squire and Tak,1975 and Howe , 1976). The project approach to evaluate irrigation investment was gaining wider acceptance over the water production function especially in the context of water becoming a scarce resource and more efficient use of this natural resource by taking into account its opportunity cost becoming more urgent (Dasgupta *et al.*, 1972; Gittinger, 1972;Carruthers, 1973;Squire and Tak, 1975; and Irvin, 1978)

By highlighting the difference between private and social costs of a project, Gittinger (1972) also cautioned against the possible under valuation of agricultural projects by ignoring indirect costs and benefits. In a project like irrigation project where huge subsidy components are involved, it may look financially attractive. However, once the subsidies are identified as the social cost of the project, it may not appear attractive economically.

According to Carruthers (1973), water was traditionally and conventionally regarded as a public utility, and therefore, evaluated on the basis of financial criteria. By recognizing water as a basic need, its role as an economic, social and environmental good was grossly over looked.

According to Rahim and Singh (1978), single purpose irrigation projects, multi purpose river valley projects, soil and water conservation projects, land

development projects, plantation of tree crops, establishment of pastures, etc. were all examples of agricultural projects characterized by the existence of spill over effects or externalities. The externality problem could be handled in project formulation and evaluation by extending the scope of benefits and costs to include all the direct, indirect and intangible costs and benefits associated with the project in question.

Two approaches were suggested to estimate the incremental net benefit from an investment project. The first approach was to identify the costs and benefits that will arise **with** the proposed project and compare them with the situation **with out** the project. The difference was considered as incremental net benefit arising from the project. The alternate approach was by comparing the situation **before** and **after** the project implementation. But, the before and after approach would fail to account for changes in production that would have occurred with out the project (Gittinger,1982).

Shamsi and Singh (1981) conducted an economic evaluation of Dhora reservoir irrigation system in Uttar Pradesh using benefit- cost analysis. The gross value of benefits due to the irrigation system was estimated from the gross value of farm output with and with out the project, and the benefits from fishing. Two discount rates were used *viz.*, 7.5 and 15 per cent, which were the interest rate on long term loans and the rate at which the Agricultural Refinance and Development Corporation financed state governments for irrigation projects. The benefit cost ratios at the two discount rates were 7.5 and 2.88 respectively, indicating that the project was economically feasible for a life span of 100 years.

Workers like Dhawan (1988b) and Singh (1994) also prefer "with" and "without project" situations over "before" and "after" project implementation for measuring difference due to irrigation. According to them, the first approach has two distinct advantages. Firstly, it reduces the elements of price inflation at two time periods and difference in weather conditions, which are not comparable.

Secondly, changes that are totally unrelated to irrigation cannot influence the changes due to irrigation when compared with a 'control' group under similar agro climatic conditions.

Suresh (2000) conducted an economic analysis of Peechi Irrigation Project in Thrissur district. The financial self-sufficiency of the project was estimated to 11.72 per cent. It indicated that the irrigation authority could not generate revenue to meet the operation and maintenance cost of the project only.

2.3 OPERATIONAL ASPECTS OF IRRIGATION PROJECTS

Dhawan (1988a) reported that for irrigation development in high-rainfall regions like Kerala, irrigation should be mainly oriented towards the non-monsoon period. It should be flexible enough to be deployed for irrigating *Kharif* crops in the event of big break in monsoon.

According to Rath and Mitra (1989), only 50 per cent of water let out in to distributaries was necessary for irrigating the standing crops and remaining 50 percent was lost in transit. So, proper assessment for need for irrigation water at different stages of crop growth, determination of frequency of irrigation, and design of a system of delivery that ensured delivery of required quantity of water at field level which was necessary to ensure more efficient use of irrigation water.

Reddy (1990) studied Ghatapabha project and exemplified the problems besieging major irrigation projects in Karnataka. The canal irrigation system was not suited for segregating the *Kharif* and *Rabi* irrigation blocks. There were not enough regulators and control structures in water conveyance system to enforce an effective system of water management, such as *Warabandhi*. Farmers had not shown readiness to observe irrigation discipline and those in the head reaches utilized more than their share of water. The small farmers received scant

consideration in sharing the benefits. Violation of cropping pattern was also common.

An economic evaluation of *Warabandhi* system of irrigation management in Chambal Command Area in Madhya Pradesh was carried out by Sisodia (1992). The introduction of the water distribution by turns according to a predetermined schedule was found to result an increase in irrigated area, cropping intensity and higher yields per hectare. There was a change in the input use pattern consequent to the introduction of the *Warabandhi* system. The relative share of production inputs like farm yard manure, chemical fertilizers and human labour, which constituted just 40 per cent of the total input cost, increased to 47 per cent after the introduction of equitable water distribution system. This was translated into higher net income per hectare on the one hand, and reduction in income differentials among the head, middle and tail reaches of the command area on the other hand.

Ahamed and Kutcher (1992) noted that with the canal irrigation, the hazard of soil salinization existed. Lining canals was the technical solution to the problem. The authors suggested a combination of measures like investment in horizontal drainage, canal lining in saline area, on farm water management in all the zones to mitigate these problems.

According to Dhawan (1993), poor drainage in canal irrigated tracts had been the bane of major irrigation works in the Indian sub continent. Absence of investment in canal lining compounded the problem. There was a tendency on the part of farmer to over use water during the course of crop growth.

The results of the study conducted by Gajja *et al* (1994) revealed that the farmers in the command area allocated large acreage to high water requirement crop and often ignored the suggested cropping pattern based on soil water plant relationship. The study suggested that cropping pattern should be strictly

implemented in the command area to avoid the problem of salinity and water logging. The farmers should be encouraged to adopt improved water management practices and conjunctive use of ground and canal water.

Chackacherry (1996) studied the management of irrigation with farmer's participation in Neyyar Project area. The study revealed that though the irrigated area had increased in the project area, productivity levels remained low and did not show any improvement. There was a huge gap between irrigation potential created and utilized. The study also highlighted the paradox of officials of irrigation controlling the irrigation systems while the real beneficiaries, viz. the farmers remaining silent spectators.

Government of Kerala (1996b) conducted a *post facto* evaluation of the Neyyar Irrigation project. The farmers in the command area were not getting sufficient quantity of water. Most of the irrigation structures and sluices were defective and conveyance losses were common. No effective measures were undertaken for the treatment of silts. The agricultural extension services were found to be poor.

Government of India (1997) laid emphasis on recognizing water as a resource to be utilized prudently. It emphasized the need to bridge the gap between the irrigation potential created and actual utilization by strengthening the organization of command area development. It was also felt that irrigation systems should ensure reduction of conveyance losses in irrigation.

Azumi (1998) reported that participatory irrigation management is the single most important step that governments could rely to improve the productivity and sustainability of irrigation projects. It required very little monetary requirements and could result in substantial cost saving to the government.

According to Sivasubramaniyan (1998) available water of Palar *Anicut* has not been diverted equitably among the four main channels of the system. Palar *Anicut* system could be improved if the physical facilities (inlet channels, bunds, channel beds, sluices and so on) are properly maintained, if necessary to be modernised and the officials should be given proper training to effectively monitor and manage the water flows at the *Anicut.*

According to Chandran *et al.* (2001) farmer's participation through (Water Users Association)WUAs under CADA is only 30 per cent in Malampuzha irrigation project. Activities such as consolidation of land holdings, group farming and adoption of suitable cropping patterns are not carried out by many of the WUAs. Farmers were found to contribute money/labour for maintenance of concrete field channels constructed by CADA in order to ensure water availability. However, scientific on farm water management through channel to field irrigation and rotational water supply did not exist for majority of WUAs. Location (reach) of WUAs on the canal network was not found to influence farmer participation since water scarcity was not a problem in the different reaches. It was also found that land holding size was influencing the participation.

Deshpande and Narayanmoorthy (2001) emphasized the importance of considering irrigation as a state subject by citing the example of Government of Maharashtra. It had a distinction of appointing a statutory irrigation commission. For irrigation development a basin wise detailed plan for utilizing the irrigation potential must be prepared by each state. To prepare plans for water utilization, mobilization of resources and implementation of schemes, autonomous river development boards should be constituted democratically. Management of water below the mainstream canal should be handed over to a group of irrigators so that the water rates could be fixed based on opportunity cost of water. Review of the situation by an independent body should be done in every ten years. This should

be followed in each of the states so that the experience across each state could be shared.

Joseph (2001) conducted an evaluation of beneficiary participation in irrigation management of the Malampuzha CADA in Kerala. The study found that the organizational and administrative pattern of the CADA was appropriate. However, the beneficiary participation was found to be low. Inter departmental conflicts, lack of co-ordination of personnel drawn from the department of agriculture, co-operation and irrigation, the differing views of engineers who controlled the operation of the system up to the sluice level on the role of Beneficiary Farmers Associations (BFAs) etc acted as factors responsible for low beneficiary participation. The beneficiary awareness about the role of BFAs as an instrument of decentralized administration, financing and management of the irrigation system was also low

Prasad (2001) realized that farmers could not play a crucial role in the management of irrigation unless they were actively involved in the same. Farmers' involvement would reduce the distribution cost and would ensure proper maintenance of irrigation system at the micro level. The understanding that they own the system would motivate economic use of water, while reliability of assured supply of water would induce them to use appropriate inputs leading to higher productivity. Farmer's participation would also be helpful in solving problems related to water distribution, water use efficiency, conflicts at farm level, collection of irrigation dues etc.

Naik *et al.* (2002) reported that Irrigation Management Transfer (IMT) has resulted in a smooth and assured availability of irrigation water vis-a-vis the non-transferred system in Mula and Bhima command area of Maharashtra. This led to increase in cropped area, shift to higher value crops, and also higher yields. Significantly large proportion of farmers, in IMT prefers WUAs for timely delivery of water and in Maharashtra farmers clearly perceived IMT as beneficial.

According to Rao(2002), Governments in the states and at the centre need to accord the highest priority to the renovation/modernization of the existing system which accounts for nearly 40 per cent of the irrigated area from the major and medium irrigation projects. The rate of returns from such investments would be very high when compared to projects for creating new irrigation potential. Modernization of delivery system and distribution channels for the existing project would have a high pay-off, as they would facilitate a clear definition of property rights or entitlements of farmers and their effective enforcement. He argued that they would also facilitate the adoption of measures by water users to improve water use efficiency and productivity.

Lee (2003), viewed that the sustainable development of water use for irrigation depends on sound system to deliver water to individual fields at appropriate time and in appropriate quantity. Many irrigation organizations were threatened by terminal decline, mainly because of inadequate funding, which was both the symptom and cause of wide spread dissatisfaction with the way the irrigation systems were managed. In Government administered irrigation projects, the charges on the users were to be incidental to the service policy and setting the budget to deliver that service. Although the Government status of the organization would guarantee its existence, changing priorities in Government funding could seriously undermine its sustainability as a service provider. Shortfalls in budget due to general shortage of funding and rising costs usually resulted in a reduction of service, which in turn discouraged users from paying any charge.

The irrigation efficiency of the canal irrigation system in India is only about 30- 40 per cent (Sivanappan, 2004). Further, in many projects, drainage was very much neglected and hence water logging, salinity etc were increasing. It resulted in reduction in productivity. By providing drainage, reusing of water and by following scientific water management practices, it was possible to increase the irrigation efficiency of the canal systems up to 50- 60 per cent.

2.4 WATER POLICY IN INDIA

Under pricing of canal irrigation was one of the major causes of over irrigation, wastage and misutilisation, leading to very low productivity (Government of India, 1976). The existing water rates in different states of India were too low to cover even the operation and maintenance cost.

State Planning Board (1977) conducted an evaluation of minor irrigation projects in all the districts of Kerala except Malappuram and Palakkad districts.The study highlighted that excess use of water was prevalent because water charge was based on the acreage irrigated .The study called for pricing of water on the basis of volume used and better control of actual water use for improving the efficiency of on farm water use.

Palaniswami (1984) noted that there was problem of over irrigation in the head reaches and under irrigation in the lower reaches in canal rrigated areas. The reason could be attributed to low water cost with the profit maximizing point likely to occur very close to the point of negative marginal product. The marginal cost of water was primarily the labour for irrigation because the water charge was on per acre rather than on volumetric basis. Generally, in canal irrigation all farmers except the tail end farmers used water more than the determined rate. There was a tendency of the on part of the farmers to over irrigate the fields with the high flows due to their favorable location there by avoiding the uncertainty of the next irrigation turn.

According to Mitra (1988), the main reason for canal network to become dysfunctional in India was largely due to tracts of irrigable command area in the middle and tail reaches not getting adequate water for irrigation. Over a period of time, the physical structure of canal network got either deteriorated or became extinct. Under the given circumstances, neither the water charges realized from the users nor the finances made available to the irrigation department were

adequate to maintain and operate systems effectively. According to him, the user must pay for the irrigation services in proportionate to the direct contribution to increase in production.

Ghatak and Singh (1994) pointed out that the defective water pricing policy followed in India resulted in numerous undesirable consequences such as wastage of precious water, water logging, and soil salinity, ultimately leading to recurring losses to irrigation authorities. The existing canal water rates were very low relative to both the cost of supplying water and the benefits from irrigation. The existing water rates in different states of India were too low to cover even the operation and maintenance cost of the projects.

Singh (1994) conducted an evaluation of the Western Gandak Canal Project in eastern Uttar Pradesh at the market prices of inputs and outputs by discounting at 10 per cent interest rate. This was the minimum interest rate charged by the financial institutions on term loans. The commercial profitability of the project was negative, with a net present value of Rs (-) 452.10 lakhs, benefit cost ratio of less than one, and an internal rate of return of 8.39 per cent. The economic evaluation with accounting prices improved the net present value to Rs. (-) 71.86lakhs, a benefit cost ratio of 0.99 and an internal rate of return of 9.74 per cent.

Whittlesey and Huffakar (1995) observed that in the past water policies and institutions tried to protect economic interest of private property rights of water. The preoccupation was to exploit and allocate a scarce natural resource for the purpose of economic development without concern for alternate uses and sectors. Therefore the future water policies shall be based on sufficient recognition of the inter relationships between water institutions, technology growth and hydrology of the water systems.

Balanced development of irrigation sector had been a hallmark of Indian irrigation planning, there by duly recognizing hydrological linkage between surface water and ground water resources. In the matter of implementation, however, deviations occurred, water being a state subject. Of late, the states with a few exceptions wavered in maintaining the pace of development of canal irrigation, leading to substantial short falls in adding to canal irrigation potential. These distortions need immediate corrections as we can neither afford short falls in new canal capacities nor break downs in already created canal capacities (Dhawan,1998)

Wolff and Hubener (1999) reported that the main problems in irrigated agriculture were degradation of irrigated cropland by salinization, alkalization, water logging, etc. Whenever water was provided at little cost to the users, neither the water managers nor the farmers had an incentive to conserve water. In irrigated farming, this could cause weakening of the "best management practices" seriously affecting the profitability of the whole enterprise in the long run.

Suresh (2000) noted that the farmers in the Peechi command area were willing to pay Rs 138/ha/year for assured and timely irrigation water which was 122.58 per cent higher than the existing irrigation charages of Rs 62/ha/year. The willingness to pay for irrigation water varied among the head reach, middle reach and tail reach farmers. The tail and middle reach farmers were willing to pay more than (Rs 162 /ha/year and Rs 127/ha/year respectively) the head reach farmers (Rs 107/ha/year). This clearly indicated that the value of irrigation water perceived was higher when scarcity of water was more.

A study by Ravi (2001) also revealed differences in the Willingness to Pay (WTP) for irrigation water among farmers in the upper, middle and tail reaches of irrigation projects. According to the study, the head reach farmers were imposing the highest social cost among the three reaches as they were using 138.4 per cent higher then the recommended water use. The WTP was the least among the head

reach farmers. Willingness to pay for water by tail reach farmers was the highest, because they placed a higher value for the timely and adequate supply of irrigation water.

Selvarajan *et al.* (2001) viewed irrigation infrastructure as one of the critical supply side constraints for enhancing future agricultural growth in India. They emphasized the need for improving the efficiency in the use of water as an input in agricultural production process in irrigation development programme so that equity in the distribution of irrigation facilities could be improved. They observed considerable inequality in the distribution of irrigated areas across farm holdings among different states and within states.

Devi (2002) conducted a study on the pricing of irrigation water in the Peechi Command area of Kerala with special reference to environmental management. The study revealed that only 26 per cent of the physical target of the area was brought under canal irrigation in the Peechi command area. The finding also indicated that irrigation water was charged lower than their financial or economic costs.

Materials and Methods

CHAPTER III
MATERIALS AND METHODS

Appropriate research design is a pre-requisite to draw meaningful inferences backed by scientific framework. The present study entitled "Impact of command area development authority: An economic analysis of Neyyar Irrigation Project" was under taken with the objective of evaluating the socio economic impact of Neyyar Irrigation Project in the command area and to identify the operational problems. This chapter is divided in to two parts *viz.*, area of study and methodology.

3.1 AREA OF STUDY

Knowledge on agro-climatic conditions and socio-economic background of the study area is of paramount importance to analyse the data appropriately and draw meaningful conclusions. Hence, the present chapter describes the agro-climatic and socio-economic backdrop necessary for the study. Relevant information regarding Thiruvananthapuram district and command area of Neyyar Irrigation Project (N I P) are presented in this section.

3.1.1. Location

Thiruvananthapuram, the capital of Kerala has a geographical area of 2186 sq km, which forms 5.63 per cent of the total area of Kerala. The district is the southern most of Kerala State and is situated between north latitudes 8° 17' and 8° 54' and east longitudes 76° 41' and 77° 17'(Figure 3.1). The district stretches along the shores of the Arabian Sea for a distance of 78 kms. Kollam district is on the north and Thirunelveli and Kanyakumari districts of Tamil Nadu are on the east and the south respectively.

Fig 3.1 Map of Thiruvananthapuram District.

There are four taluks viz., Thiruvanthapuram, Chirayinkeezhu, Nedumangadu and Neyyattinkkara in the district spread over 84 *Grama panchayats* and 12 Block panchayats (Table 3.1). Thiruvananthapuram Corporation, Varkala, Attingal, Nedumangad and Neyyattinkara Municipal towns are the urban centres in the district.

Table 3.1 Details of Thiruvananthapuram district in a glance

Sl No	Items	Units	Year of Reference	Number/ Quantity
1	Taluks	Nos	1996	4
2	Blocks	Nos	1996	12
3	Panchayat	Nos	1996	84
4	Municipalities	Nos	1996	4
5	Corporations	Nos	1996	1
6	Households	1000 s	1991	620
	Male	Lakhs	2001 census	15.71
	Female	Lakhs	2001 census	16.63
	Total	Lakhs	2001 census	32.35
9	Density	Pop/m^2	1991 census	1476
10	Literacy rate	%	2001 Census	89.36
11	Main workers	1000 s	1991 Census	888.61
12	Marginal workers	1000 s	1991 Census	72.11
13	Work participation rate	%	1991 Census	32.60
14	Individual operational holdings	1000 s	1995-96	768.68

Source: Government of Kerala, 2003

Thiruvananthapuram has certain special features compared to the rest of the regions in Kerala. These include rapid urbanisation, fast development of service sector, high level of literacy and education, strong political trade union movement, and high level of unemployment. However, the setting of farm front in the district is more or less similar to the rest of the regions of the state (Nair, 2000).

3.1.2 Land Utilisation Pattern

Land utilisation pattern of Thiruvananthapuram is presented in Table 3.2. The total cropped area is 189722ha. The cropping intensity of the district is 133 per cent. The net area sown is 65.21 per cent of the total geographical area.

Table 3.2 Land utilisation pattern in Thiruvananthapuram district during the year 2002-2003

Description	Area (in ha)	As percentage to the total
Geographical area	218600	100.00
Forest	49861	22.80
Land put to non-agricultural uses	23542	10.76
Barren and uncultivable land	484	0.22
Permanent pastures and grazing land	9	0.004
Land under miscellaneous tree crops not included in net area sown	104	0.05
Cultivable waste land	323	0.15
Fallow other than current fallow	446	0.2
Current fallow	1290	0.6
Net area sown	142541	65.21
Area sown more than once	47181	21.58
Total cropped area	189722	86.78
Cropping intensity		133.10

Source: Government of Kerala, 2004a

A clear delineation of the geographical area in to three distinct regions *viz*, coastal, midland and highland is visible in the state.

3.1.3 Demographic Features

According to the 2001 census report, Thiruvananthapuram district supports a total population of 3234707. Out of this 1571424 (48.58 %) are males and 1663283 are females (51.42%). During the last decade (1991-01), the district showed a population growth rate of 9.78 per cent (Government of Kerala, 2003).The density of population is 1476 persons per square kilometre as on 2001. The sex ratio of the district indicates there are 1058 females for 1000 males. The per capita income is Rs 20484 and the literacy rate is 89.36 per cent.

3.1.4 Occupational Distribution

Agricultural labourers constituted nearly 4.98 per cent of the total population in the district while cultivators constituted 1.6 per cent. Further details on the occupational distribution of workers Thiruvananthapuram district during 2001 are depicted in the Table 3.3.

Table 3.3 Occupational Distribution of workers in Thiruvananthapuram district during the year 2001

Category of Workers	Persons (Number)	Per cent to total population
Cultivators	54652	1.69
Agricultural Labourers	161115	4.98
Workers in household industry	44040	1.36
Other workers	788644	24.38
Total Population	3234707	

Source Government of Kerala, 2003

3.1.5 Climate and Rainfall

The average rainfall from 2001-2003 was maximum in the month of October followed by June (Table 3.4, Figure 3.2). Most of the rain is received during South West and North East monsoon. Maximum temperature is recorded in the month of April.

Table 3.4 Monthly temperature and rainfall distribution in Thiruvananthapuram district in the year 2002

Month	Minimum temperature^0 C	Maximum temperature^0 C	Mean Rainfall during 2001-2003 (mm)
January	22.4	32.6	20.1
February	22.7	32.4	28.4
March	23.6	33.3	40.06
April	24.6	33.5	175.2
May	24.6	32.1	18.76
June	23.7	31.2	289.30
July	23.5	30.9	257.67
August	22.9	30.8	163.60
September	23.1	32.6	225.77
October	23.0	31.0	320.5
November	23.0	31.0	187.6*
December	22.3	32.3	48.5*

Source: Government of Kerala, 2004c

*Average for 2002 and 2003

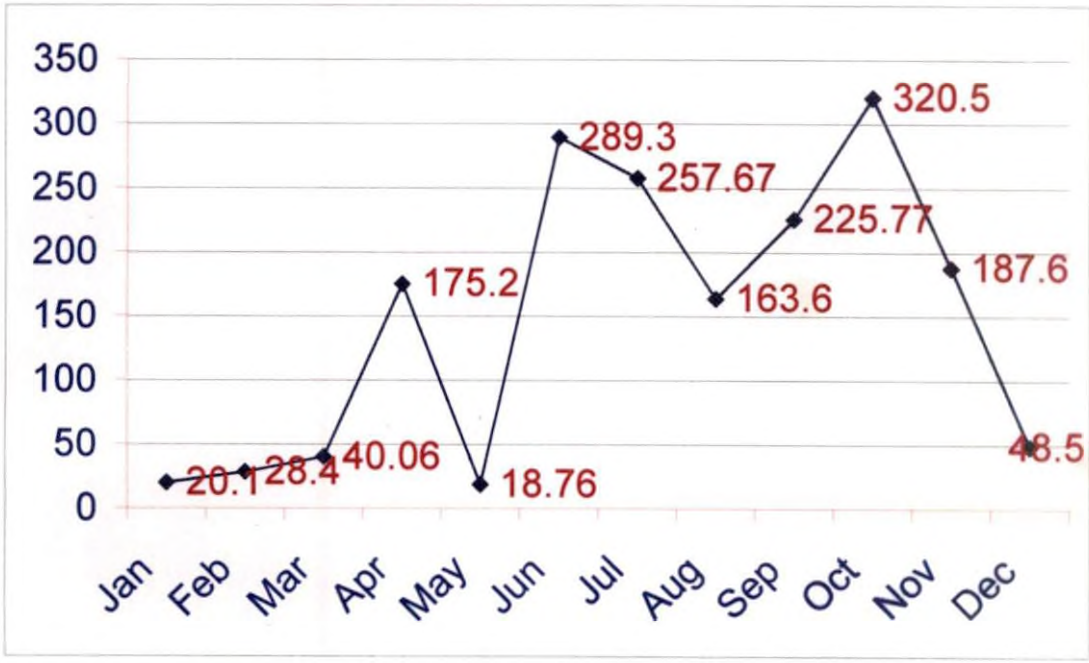

Fig. 3.2. Average monthly rainfall Thiruvananthapuram during 2002

3.1.6 Soil

There are three major types of soil in the district. In the midland part of the district, fairly rich brown loam of laterite is seen. Western coastal region has sandy loam soil. The Eastern hilly parts of the district have rich dark brown loam of granite origin (Government of Kerala, 2004c).

3.1.7 Cropping Pattern

The cropping pattern of the district is shown in Table 3.5. Important crops grown in the district are coconut, rubber, tapioca, vegetables, banana and paddy. Coconut is the major crop cultivated in the district. It accounted for 45.92 per cent of the total cropped area. This was followed by rubber and tapioca, which occupied around 15 per cent and 13 per cent of the cropping pattern respectively. Paddy occupied around three per cent of the cropping pattern only.

Table 3.5 Cropping pattern in Thiruvananthapuram district during the year 2002-03

Crop	Area (ha)	Percentage to total
Paddy	6423	3.39
Pulses	547	0.29
Pepper	6569	3.46
Ginger	106	0.06
Arecanut	1216	0.64
Banana	2496	1.32
Tapioca	23922	12.61
Vegetables	4888	2.58
Coconut	87118	45.92
Rubber	28415	14.98
Others	28022	14.75
Total cropped area	189722	100.00

Source: Government of Kerala, 2004a

3.1.8 Background Information Regarding Neyyar Irrigation Project

The Neyyar river originates from the *Agasthyarkoodam* hills of Western Ghats and traverses about 40kms before reaching the Arabian sea. Neyyar river is the southern most river of Kerala. All the water from the Neyyar river was flowing in to the Arabian sea with little or no benefit to the country causing untold havoc, each year due to the flood. The tributaries of the Neyyar river are the *Valliyar,*, the *Mullar* and the *Kallar.*

According to available details, there were 1716 tanks in the Neyyattinkara taluk. However these tanks could hold only limited quantities of rainwater and the rest over flows in to the canal networks and ultimately reaches the Arabian Sea. Neyyatttinkara taluk is the southern most taluk in the Kerala state. Originally, the farmers mainly depended on rains for their water. Rain water gets collected in the available tanks or ponds and from there it flows in to the fields through channels, mostly natural. The channels are popularly known as canal networks.

Frequent failure of monsoons caused considerable damages to the farmers and the local economy started crippling. On account of this failure of rains and consequent unserviceability of these tanks, there was considerable agitation from local agriculturists. With a view to suggest a remedial measure to this problem and to suggest suitable proposals for exploiting water potential of Neyyar river government sanctioned an investigation estimate on the possibility of a dam. As a result of this investigation, it was observed that there were three sites along the course of Neyyar, which could be considered as a suitable dam site for the project. The sites identified were Aruvikkara, Aruvipuram, Kottappara.

These proposals did not receive serious attention until the end of the World War II. Soon after the cessation of the hostility each state turned its attention to post war development giving top priority to food production. The Chief Engineer submitted a proposal to take up an investigation for an irrigation

project in the Neyyar river. The Government accepted the proposal and sanctioned an investigation amount of Rs.27000/. The scheme was investigated not as a multi purpose project as originally envisaged, but purely as a major irrigation under taking to meet the acute scarcity of water and help to produce as much food as possible. A site at Chempilamoodu 0.5 km upstream of the Pangappara site and about 29 km east of Thiruvananthapuram city was investigated and fixed for the construction of the dam.

The proposals consisted of

(1) A straight rubble masonry dam of 56m height across the Neyyar River.

(2) A reservoir having water spread of 9.10 sq km at full reservoir level.

(3) A water distribution system consisting of two main canals one on the right bank and another on the left bank and their branch canals and distributaries planned to irrigate two crops of paddy in an area of 16042ha.The Government accepted this and the scheme was included in the First Five Year Plan of *Travancore-Cochin* State. The construction work on the project was begun in 1952.During the execution, for convenience, the work was divided in to two stages namely Stage I and Stage II.

3.1.8.1 Stage I

The construction of the dam and Right Bank Canal (R.B.C) system come under this stage. The Government sanctioned an estimate amounting to Rs143 lakhs and the work commenced on 1-1-52. Revision to the original estimate was done twice. Besides the construction of dam, R.B.C. main canal, branch canals and field boothies having a total length of 170 km had been constructed under the first stage. Irrigation to the part of RBC command area was started during 1964.

3.1.8.2 Stage II

Construction of Left Bank Canal (L.B.C) System was done under the second stage. The original estimate of Rs.105 lakhs were revised to Rs.170lakhs and sanctioned by the Government, which was revised several times.

3.1.9 Salient Features of N.I.P

The NIP is located on Neyyar river in latitude $8^0 32'$ longitude $77^0 9'$ at Chempilamoodu in Thiruvananthapuram city(Plate 3.1). It is straight gravity rubble masonry type with the volume of rubble masonry 124650cum.

The total catchment area of the project is 140km^2. The watershed has a mean annual rainfall of 2256 mm. The maximum annual rainfall is 3048mm. Annual run off is estimated to be 240.7 Mm^3. The expected maximum flood discharge is 809.4 cumecs. The technical details about the dam is furnished in Table 3.6

Plate 3.1 A view of Neyyar Irrigation Project

Table 3.6 Details about dam and reservoir

Normal bed level	+46.93m
Deepest foundation level	+29.565
Parapet level at top	+86.559
Road level at top	+85.645
Height above deepest foundation	56.08m
Length at top	294.83m
Width of Road at top	4.5m
Top width including operating platform:	7.54m
Maximum width	38.02m
B.Reservoir Full Reservoir Level (FRL)	+84.75
Gross storage at FRL	$106.2Mm^3$
Water spread at F.R.L	$9.10km^2$

Source :Department of Irrigation , Thiruvananthapuram

3.1.10 Water Distribution System

The water distribution system of the project consists of,

1.The Left Bank Canal of length 32.82 km (Figure 3.3), and

2. The Right Bank Canal of length 33.40km (Figure 3.4).

Both the above canals have branches running across the length and breadth of the Neyyattinkara taluk, serving almost all the places where the agricultural produces are grown. The left bank canal system including its branches and field boothies were proposed to serve an ayacut of 7745 ha including 3725 ha in the state of Tamil Nadu. The major branches of the left bank canal are given in Table 3.7.

Sl No.	Name of canal	Length (m)
1	Left Bank Canal	33000
2	Perumkadavil	4000
3	Chaikkottukonam	8000
4	Chaikkottukonam	4000
5	Kollayil	12000
6	Amaravila	5000
7	Nochiyoor	3500
8	Mariyapuram	3500
9	Chenkal minor	4300
10	Chenkal major	7582
11	Karumanoor right	7870
12	Karumanoor left	2000
13	Kollamcode	24000
14	Viyanoor	2000
15	Kanyakumari	NA

NA - Not Available

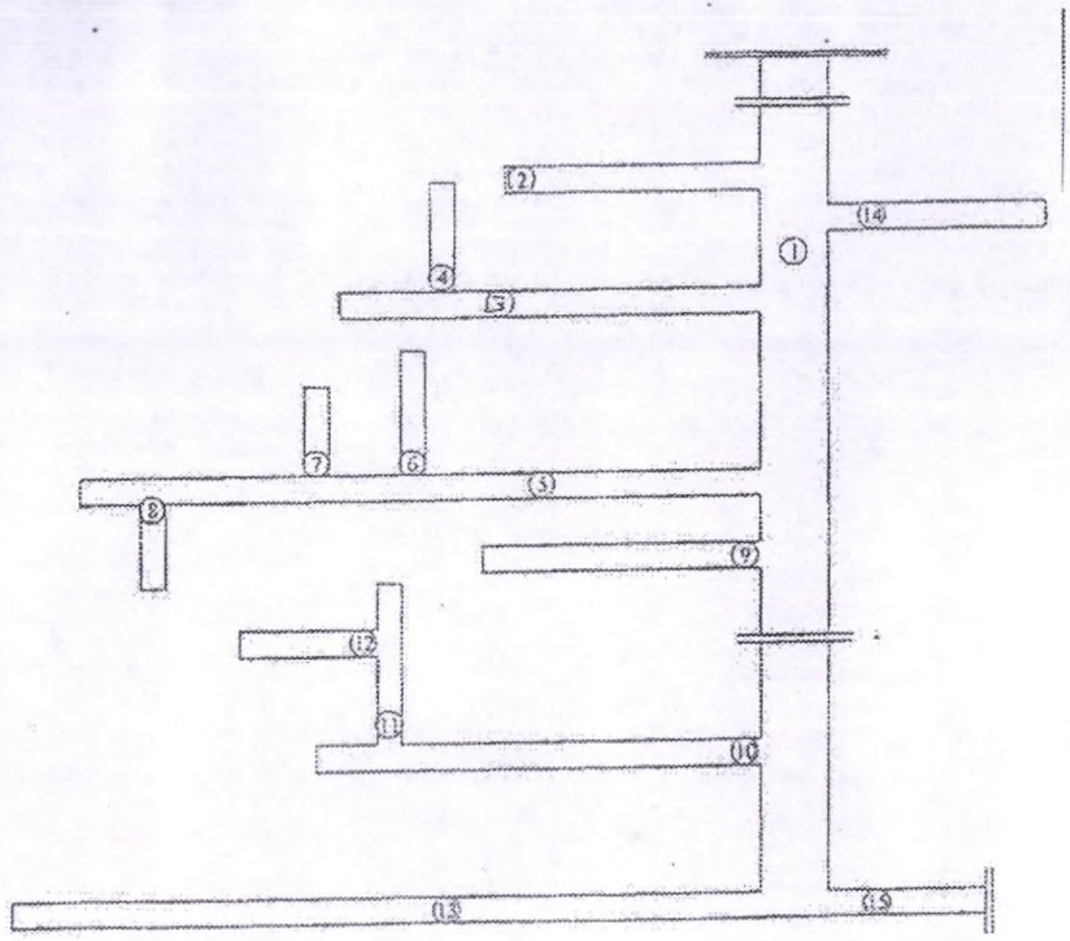

Fig. 3.3 Cut off diagram of Left Bank Canal

Sl No.	Name of canal	Length (m)
1	Right Bank canal	33000
2	Vadacode	8000
3	Vizhinjam	21000
4	Marukil	8450
5	Vellayani north	9320
6	Vellayani east	3420
7	Vellayani west	11054
8	Poovar west	21000
9	Chowara	21000
10	Poovar east	18000
11	Olathanni	7000

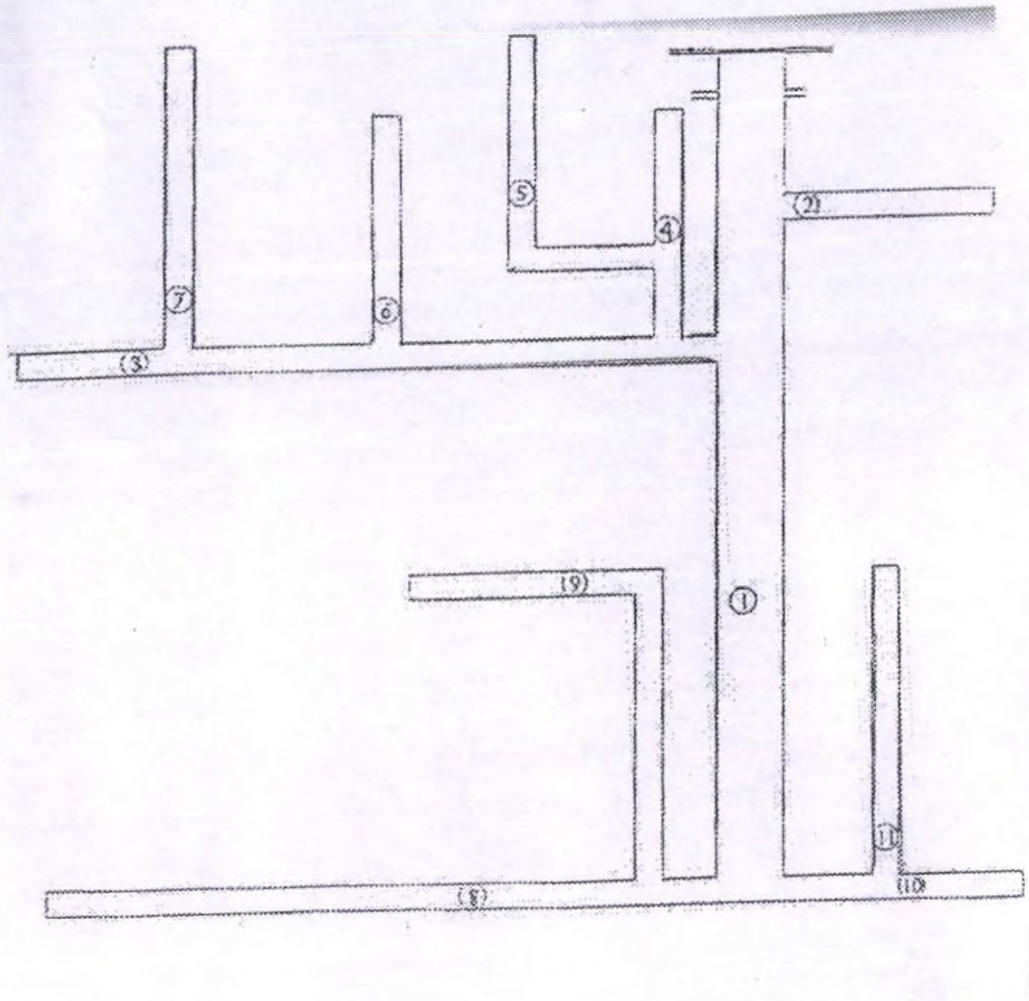

Fig. 3.4 Cut off Diagram of Right Bank Canal

Table 3.7 Major branches of left bank main canal

Sl No	Name of branch	Distance in Km
1	Perumkadavila	4.0
2	Chaikkottukonam Main	8.0
3	Chaikkottukonam Sub	4.0
4	Kollayil	12.0
5	Amaravilla	5.0
6	Nochiyoor	3.5
7	Mariyapuram	3.5
8	Chenkal Minor	4.3
9	Chenkal Major	7.6
10	Karumanoor Right	7.9
11	Karumanoor Left	2.0
12	Kollemcode	24.0
13	Viyannoor	2.0
14	Kanyakumari	N.A

Source: Department of Irrigation , Thiruvananthapuram

The Right bank canal system including its branches and field boothies were proposed to serve an ayacut of 7635ha(entirely in Kerala). The major branches of RBC is given in Table 3.8

Table 3.8 Major branches of Right bank main canal

Sl No	Name of the branch	Distance in km
1	Vadacode	8.0
2	Vizhinjam	21.0
3	Marukil	8.45
4	Vellayani North	9.32
5	Vellayani East	3.42
6	Vellayani West	11.05
7	Poovar West	21.0
8	Chowara	21.0
9	Poovar East	18.0
10	Olathanni	7.0

Source :Department of Irrigation, Thiruvananthapuram

The irrigation potential of the NIP is 16042ha. Out of this, the ayacut envisaged for Kerala is 11655ha.The total irrigation requirement at canal head for a full year is arrived at 170.64Mm^3 and the average inflow in to the reservoir for

the last twenty years is around 295Mm^3. Thus the inflow in to the reservoir is sufficient to make the irrigation requirements. The major components such as dam, head works and canal system are capable of irrigating the ayacut, provided the loss of water transmission is regulated also the design cross sections of almost all the channels are capable of carrying the envisaged discharges of these respective channels. The ayacut of NIP mainly lies in Neyyatinkara, Nedumangadu and Thiruvananathapuram taluks. The details about the number of households, density of population, literacy level, etc about the command area are furnished in Table 3.9.

Table3.9.Details of selected panchayats

Sl. No.	Name of Panchayaths	Area in km^2.	No. of Wards	No. of house holds	Total Population including Institutional and Houseless population			Density of population (No/km^2.)	Sex Ratio Female/ 1000 Males	Effective Literacy Rate		
					Male	Female	Total			Male	Female	Total
1	Athiyannoor	12.44	10	5373	11508	12007	23515	1890	1043	95.68	90.42	92.99
2	Pezhumathor	18.91	12	7360	16315	16736	33051	1748	1026	93.24	87.05	90.10
3	Kallikkad	106.27	8	2803	6275	6165	12440	117	982	91.50	83.46	87.51
5	Pallichal	21.70	12	8226	8366	19458	27824	38896	1792	999	93.16	86.42
6	Vengannoor	10.12	11	6201	14360	14382	28742	2840	1002	93.00	86.84	89.91
7	Marukil	16.38	11	6191	14246	14500	28746	1755	1018	94.55	89.38	91.93
8	Nemom	12.18	13	8853	20684	21223	41907	3441	1026	95.90	90.22	93.01
9	Balaramapuram	10.53	11	6468	15847	15712	31559	2997	991	92.34	84.75	88.56
10	Kalliyoor	17.23	11	6814	15722	15857	31579	1833	1009	93.91	88.00	90.93

Source: Government of Kerala,2003

3.1.3.Command Area Development Authority

The Command Area Development Authority (CADA) had been implemented as a centrally sponsored scheme since the Fifth Five Year Plan (FYP). The cost of the following items was shared on a 50:50 basis between centre and state. The central government would bear

1.The cost of establishment of CADA and the constitution of water utilisation and command area development department.

2.Soil survey and preparation of farm plan.

3.Equity capital support to land development corporations, farmers society etc, for providing institutional finance for farmers for the construction of field canal, field drains, land levelling and land shaping.

The state government would have direct responsibility in the following activities.

1. Strengthening of existing extension organization.
2. Strengthening of infrastructure including communication system to handle increased production.
3. Remodelling and modernisation of delivery system.
4. Creation of basic infrastructure.
5. Maintenance of road drainage and irrigation system.

The Government of India had selected 51 irrigation commands with a total cultivable command area of 13 millionkm^2 in 16 states including Kerala during the Fifth FYP. The irrigation commands selected in Kerala were Malampuzha, Peechi and Chalakkudi. In view of the smaller size of the projects in Kerala it was felt to include all other commissioned projects in Thrissur, Palakkad and Thiruvananthapuram district. Thus, Neyyar irrigation project was included under the command area development programme (Government of Kerala, 1996b).

During April 1980, Government of India had revised the scheme of financial assistance as follows.

The cost would be shared on 50:50 basis between centre and state for

1.The establishment of command area authorities,
2.Topographical and soil surveys,
3.Preparation of farm plans on farm development works including land-levelling.
4.Field drains
5.Formulation and enforcement of turn scheduling of water (*Warabandhi)*,
6.Adaptive trials,
7.Demonstration and training.

The central assistance would be in the form of grants to state government. *Warabandhi* involves supply of water to each individual field owner on the basis of land owned by him. The main work under the programme was construction of field channels. Field channels under the scheme are defined as small water canal and with in the outlet command of about 60 ha. Having the same carrying capacity the pipe outlet usually 1.0 to 1.5 cusec which deliver water from the outlet to each individual field.

3.1.11.1 Organisational Set up

The Chairman of the CADA is the Secretary to government, Irrigation Department (now named as Water Resources Department). The authority consists of two members of legislative assembly, ten farmer's representatives of command area, Government officials and representatives of credit agencies. To assist the authority in the discharge of the function, Administrator (Chief Engineer), Water Management Specialist, and technical officers from the Department of Agriculture Co-operation and Soil Conservation as supporting staff. The administrator is the executive officer of the authority and head of the office. The project head quarters

is situated at Thrissur. There are six divisions one each at Palakkad, Trichur, Neyyattinkara, Perumbavoor, Chengannur, and Perambra under the control of project head quarters with executive engineers as executional heads.

3.1.11.2 Farmers Participation

The CADA of Neyyar Irrigation Project was started in 1985-86. CADA of Kerala has a pyramidal structure of functioning. It has a continuous chain of beneficiary organisation like farmers association, canal committee, project committee and apex authority. All these bodies are representative organisation of lower associations. Farmers association is the basic unit of CADA. Members of the association are the beneficiary farmers in the ayacut of a spout in the canal. Therefore these spouts will have representative farmers association, which are registered under the Societies Registration Act. Neyyar CADA had organized 317 Beneficiary Farmers Association.

Various programmes implemented through CADA in NIP include adaptive trial, training sponsored by Government of India (GOI) and Government of Kerala (GOK), subsidies to small and marginal farmers, land levelling and shaping, reclamation of water logged areas, field drain construction, and survey design and planning, construction of field channel, construction of farm road, improvement tanks, *warabandhi*, demonstration, managerial subsidy and ground water development.

As most of envisaged activities are nearing completion, GOI withdrew the central assistance of the CADA with effect from 31.03.2003. Now the state government has introduced a revamping and consolidation programme for augmenting the water use efficiency of NIP. Detailed base line study is being carried out.

3.2 METHODOLOGY

3.2.1 Sampling Frame Work

The study was conducted in Thiruvananthapuram district. As NIP is the only major completed irrigation project in the district, the command area of the project in the district was purposively selected for the study.

3.3.1.1 Selection of Study Area and Sampling Design

The study was based on primary and secondary data. Secondary data relevant to the objective of the study were collected from the office of the Investigation and Planning, Chief Engineer, Thiruvananthapuram, CADA, Neyyar Irrigation Project, Thiruvananthapuram; Office of the Accountant General, Thiruvananthapuram; Bureau of Economics and Statistics, Thiruvananthapuram and State Planning Board, Thiruvnanthapuram.

The primary data were collected by interviewing the respondent farmers using a pre tested, well-structured schedule of enquiry (Appendix-1). The RBC (Plate 3.2) was purposively selected for the study after consultation with the CADA officials because the entire command lies in Kerala. Two stage stratified random sampling was employed for collecting the data. The stratification was based on the length of the canal. The ayacut of RBC is spread over Thiruvananthapuram, Neyattinkkara and Nedumangadu taluks of Thiruvananthapuram district. The RBC was divided into three strata *viz* head reach, middle reach and tail reach. The list of beneficiary farmers association from each of the three reaches was collected from the office of the Executive Engineer, CADA, Neyyattinkara. Two BFAs were selected at random from each of the three reaches as second unit. From each BFA, 10 farmers were selected randomly in the third stage making 60 beneficiary farmers in the sample (Table 3.10). Ten each non-beneficiary farmers were also selected randomly from the near by area of the

Plate 3.2 Right Bank Canal- A view from the dam

BFA making 60 non-beneficiary farmers in the sample. The sample consisted of 60 beneficiary farmers and 60 non-beneficiary farmers. Thus the sample size of the study was120.

Table 3.10. Details of BFAs selected from the three reaches

Sl no	Name of BFA (*Karashaka samithi*)	Strata	Ayacut area (ha)
1	Kallikkadu	Head	12-17
2	Thembamuttom	Head	42-46
3	Pezhoorkkonam	Middle	17-18
4	Thumbottukonam	Middle	22-44
5	Olathanni West	Tail	22-82
6	Thottam	Tail	27-49

Source: CADA, Neyyattinkara

3.2.2 Period of Study

The secondary data pertained to the period from 1976-77 to 2002-03.The primary data pertains to the agricultural year 2003-2004. The data collection was carried out during the period of April-May, 2004.

3.2.3. Main Items of observations

The main items of observations made were

a) Major socio-economic characteristics of the beneficiary farmers such as family size, caste, level of education, size of land holding, tenurial status, pattern of farm investment, cropping pattern, cropping intensity, farm and non farm income.

b) Production expenses of major economic enterprises covering labour use pattern, level of mechanisation, machinery hiring, soil and water conservation measures, plant nutrient supply, plant protection operations.

c) Water charges paid or payable.

d) Subsidy received.

e) Yield level.

f) Level of participation in BFA meetings –positions occupied in BFA.

g) Operational problems in the command area.

3.2.4 Analytical Frame Work

3.2.4.1 Components of Operational Costs

a) Cost of land preparation

The cost on land preparation accounted for a remarkable component of the cultivation cost. Generally, male labourers carry out these operations. No farmer reported the use of animal power or mechanical power for land preparation. The average wage rate prevailing in the area ranged from Rs150 for male labourers and Rs 125/day for female labourers.

b) Cost of planting material

All the purchased planting materials were valued at the market price. Planting materials raised in the farm were valued at the prevailing market price.

c) Cost of organic manures

Cow dung, wood ash, poultry waste and neem cake are the items of organic manures used by the farmers. For coconut they apply cow dung and wood ash. Some farmers used common salt as a soil ameliorant. These were valued at

the prevailing market rates. Actual costs of these items were calculated considering the transportation costs also, wherever applicable.

d) Cost of Chemical Fertilisers

The cost of chemical fertilizers used was calculated based on the actual prices plus transportation cost paid by the sample farmers.

e) Cost of plant protection chemicals

This cost includes the cost of plant protection chemicals and other bio pesticides used against pest and diseases in crops. Most of the farmers used chemical pesticides. The use of bio-pesticides was low.

f) Cost of fuels

Cost of fuel includes cost on electricity or diesel incurred in connection with the operation of the pump sets for irrigation.

g) Land rent

Leasing was very prevalent in the area especially in cultivation of banana. Therefore the rent paid by tenant farmers formed an additional cost component in such cases. The land rent was reckoned at the actual rent paid by the tenant farmers.

h) Cost of staking

Only the banana growers incurred this cost. This includes the cost for staking the banana in order to protect it from the wind. Some farmers used rope while others used rope and poles for staking. When fully consumable items like

rope alone were used the full cost was accounted. When items such as wooden poles were also used, one third of the purchase price of poles was used because the poles can be used for three consecutive years.

i) Cost of hiring machinery

It includes cost of hiring machineries like pump sets, spade etc. Such practices were more prevalent among the non-beneficiaries. The actual rent paid was taken as cost for this item.

j) Depreciation

The straight-line method was employed for working out the depreciation. The average economic life of the depreciable items were taken as follows:

Permanent farm buildings	– 15 years
Temporary farm buildings	– 5 years
Livestock	–10 years
Pumpsets	– 10 years
Light implements	– 5 years

The amount of depreciation to be charged during a year is estimated as:

$$\text{Depreciation} = \frac{(\text{Purchase cost} - \text{salvage value})}{\text{Life of the asset}}$$

Depreciation on individual items of fixed capital is added together to get the total value of depreciation.

3.2.4.2 Income Measures

The following income measures associated with different cost concepts were also used to measure the efficiency.

1) Gross income

Gross income represents the total value of the main product as well as the bye-product, which were valued at the prevailing market price.

2) Gross margin

Gross margin is obtained by deducting the operational expenses from the gross income (Johnson, 1991).

3.2.4.3 Area Utilisation Index (AUI)

The area utilisation index (AUI) was worked out by dividing the actual area irrigated by the targeted area using the formula (Dhawan, 1998a; Suresh, 2000).

$$AUI = \frac{\text{Actual irrigated area}}{\text{Targeted irrigated area}} \times 100$$

3.2.4.4 Rainfed Based Yield Index

Rain fed based yield index is estimated by dividing the yield of the crops in the command area by the average yield in the non irrigated (rainfed) area in the district. It gives an idea about the contribution of irrigation to crop production (Dhawan, 1998a; Suresh 2000).

$$RBYI = \frac{Y_{ic}}{Y_{rd}}$$

Where,

Y_{ic} is the yield of the i^{th} crop in the command area

Y_{rd} is the rainfed based yield of the i^{th} crop in the district.

3.2.4.5 Financial Self Sufficiency

The Financial Self Sufficiency (FSS) is a measure of percentage of operation and maintenance cost recovered through the revenue generated by the project (Dhawan, 1998a; Suresh 2000). It is worked out as

$$FSS = \frac{\text{Revenue from irrigation}}{\text{Total O \& M expenditure}}$$

Where, the revenue from irrigation constituted the water charges, and the operation and maintenance (O&M) expenditure included the amount spent for the operations and maintenance of the irrigation system, including the subsidies received from the government in this regard.

3.2.4.6 Financial Analysis

As an *ex post* financial analysis was carried out, the financial rate of return was estimated based on the direct costs and benefits by considering the subsidies received as a benefit component (Gittinger, 1984). The following measures were used in determining the financial impact :

a) Benefit Cost Ratio (BCR)
b) Net Present Value (NPV)
c) Financial Rate of Return (FRR)

For estimating these parameters cost and returns were discounted at 12 per cent rate of interest, being the prime agricultural term lending rate prevailing during the period of reference.

a) Benefit Cost Ratio

The Benefit Cost Ratio (BCR) indicates the returns on a rupee of investment. It is the ratio between the present worth of benefits and that of costs (Gittinger, 1984). A project with benefit cost greater than unity is considered viable. The BCR was estimated as

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

where,

B_t = Benefits in the year t

C_t = Costs in the year t

i = Discount rate

n= Project life in years

b) Net Present Value (NPV)

This is the most straightforward discounted cash flow measure of the project worth. This is simply the present worth of the net cash flow stream (Gittinger, 1984). In other words it is the difference between present worth of benefits and present worth of costs. The formal selection criteria for the Net Present Value (NPV) measure of project worth is to accept all projects with a positive net present value when discounted at opportunity cost of capital.

Symbolically, Net Present Value (NPV) is

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

where the terms are explained earlier.

c) Financial Rate of Return

Another way of using discounted cash flow for measuring the worth of a project is to find the discount rate, which makes the net present value of the cash flow equal to zero. This discount rate is termed the Internal Rate of Return (IRR) and it represents the average earning power of the money used in the project over the project life (Gittinger, 1984). Since the IRR was estimated based on the direct cost and benefits of the project valued at the market price, it denotes the financial rate of return of the investment.

Symbolically, the Internal Rate of Return (IRR) is the that discount rate "i" such that

$$IRR = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+i)^t} = 0$$

where the terms are as explained earlier.

3.2.4.7 Cost Pricing

The cost pricing of irrigation water is based on the logic that the water charges shall be based on the cost of developing and maintaining an irrigation

system. whether major or minor. Accordingly the cost pricing of the present irrigation system was worked out as

$$\text{Cost} = \frac{\text{Total cost (Capital Investment + Operation and maintenance cost)}}{\text{Total area benefited (irrigated)}}$$

The capital recovery factor (CRF) is used to annualise the capital investments of long-term nature (Ayres, 1983). CRF is more appropriate for big irrigation projects that last beyond 50 years. The CRF was estimated as:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

where,

i = Discount rate (12 % in the present case)

n = project life in years (80 years in the present case)

So the cost pricing of the present irrigation system was re worked out as

$$\text{Cost} = \frac{\text{CRF *Capital Investment+ Average O \&M}}{\text{Total area benefited (irrigated)}}$$

3.2.4.8 Willingness to pay

The details on Willingness to Pay (WTP) to get more assured and timely supply of water were elicited from the farmers. They were asked to give the amount they were willing to pay to get assured water supply through out the year and it was quantified on a per hectare basis.

3.2.4.9. Additional Employment Generation

The shift in cropping pattern lead to a change in area of crops cultivated over the years. This is associated with change in labour use pattern also. The change in area of crops cultivated is multiplied by the respective labour requirement to arrive at the additional employment generated or lost. The wage rate of the respective period was used to quantify these changes in money terms.

3.2.4.10 Economic analysis

Economic analysis is done from the angle of benefits accruing to the society (ie. the whole economy). Here, every subsidy is treated as a cost to the economy and tax is treated as benefit to the economy (Gittinger, 1984). Indirect benefits like incremental income resulting from higher crop productivity, cropping intensity, additional employment generated are also quantified and incorporated into cash flows during economic analysis. Hence, the IRR arrived is designated as the Economic Rate of Return (ERR).

3.2.4.11 Type of participation

Type of participation of farmers in the BFA meetings was analysed by classifying in to four categories *viz* interactive participation, participation by agreeing to decisions, participation for materials and subsidies and passive participation. The farmers were asked about the type of the participation. The attitude of the farmers was also considered while deciding the type of participation. The percentage of farmers in each group was found out by tabular analysis.

3.2.4.12 Operational problems in on farm irrigation

The constraint in on farm irrigation were enumerated and ranked from the farmers view in the order of importance assigned by them. The ranks were assigned depending upon the scores bases on the relative importance attributed by the respondent farmers.

3.2.4.13 Standard Hectare

In crops like rice the agro techniques including seed rate and spacing (there by plant density in a unit area) are standardised. However, a wide variation of plant density is observed in the case of perennial crops like coconut, arecanut, cashew etc and annual crops like banana. In order to overcome this problem, the Directorate of Economics and Statistics and the National Bank for Agriculture and Rural Development (NABARD) have evolved a concept of "standard hectare" for such crops, consisting of a particular number of plants based on the recommended spacing. This concept has been used for coconut and banana in the study. One standard hectare of coconut consists of 175 palms, while that of banana *(Nendran)* consists of 2000 plants.

3.2.4.14 t-test

The statistical significance of the parameters like yield and gross income were carried out using the t test. The t test was done assuming equal variances. The estimator was worked out using the following equation (Croxton *et al*, 1988):

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{S^2\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

Degrees of freedom $(n_1-1) + (n_2-1)$

S^2 ⟶ pooled estimate of variance

$\overline{X_1}$ ⟶ mean of first sample

$\overline{X_2}$ ⟶ mean of second sample

n_1 ⟶ Number of observation in first sample

n_2 ⟶ Number of observation in second sample

The difference between the parameters of the beneficiary and non-beneficiary farmers are considered statistically significant as long as the calculated t value was higher than the table t value at the respective degrees of freedom.

Results and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

The present study on "Impact of Command Area Development Authority (CADA): An Economic Analysis of Neyyar Irrigation Project" was under taken with an objective of assessing the socio economic impact of Neyyar Irrigation Project in the command area and to identify the operational problems. The results of the study are summarised under the following heads.

4.1 SOCIO - ECONOMIC CHARACTERISTICS

An analysis of the socio-economic characteristics of the sample farmers will throw light on the biophysical, organisational and institutional environments within which the farming units function and the farming practices are being integrated. Hence, an attempt has been made to analyse the socio-economic parameters that have a direct or indirect bearing on the farm resource use.

4.1.1Farm Size Status

4.1.1.1 Owned Holding Size

As the size of operational holding is a major barrier to achieve economy of scale in farm operations, an analysis of the farm size assumes importance in understanding the decision making process in a farm household. The details about farmers based on their owned holding size is presented in Table 4.1

The average owned holding size of beneficiaries was 0.44 ha. Even though there was no marked difference in the size of holding among the farmers in the head, middle and tail reaches, the sample farmers in the middle reach had a slightly higher holding size (0.55 ha). There was no significant difference in the average owned holding size among beneficiaries and the non-beneficiaries.

4.1.1.2 Tenurial status

Details of the tenurial status of the sample farmers are given in Table 4.1. Farm operators in an area can be owner-cultivators or tenant-cultivators. Tenant is a person who pays rent to a landlord for the use of land. Economic theory suggests that leasing of land is conducive to its more rational use especially in labour surplus economies with skewed distribution of land holdings (Raj, 1975). Various types of tenancy existed in Kerala, ranging from formal tenancy to tenancy at will. However, the Kerala Land Reforms Act 1963 (as amended in 1969) abolished landlordism in the state and conferred ownership rights to cultivating tenants. Since then, only informal leasing is in vogue in the state (Kumar, 1991). Here, the land is leased strictly for a short period out of the landowner's fear of further protective legislations in favour of tenants.

Table 4.1 Owned, leased in and operated area of sample farmers

Category	Owned		Leased		Total	
	No of farmers	Operated area(ha)	No of farmers	Leased in area (ha)	No of farmers	Average total operated area(ha)
Head	9 (45)	0.34	11 (55)	0.48	20 (100)	0.50
Middle	16 (80)	0.55	4 (20)	0.90	20 (100)	0.61
Tail	16 (80)	0.42	4 (20)	0.33	20 (100)	0.43
Beneficiaries (mean)	41 (68.33)	0.44	19 (31.67)	0.54	60 (100)	0.51
Non beneficiaries	37 (61.67)	0.45	23 (38.33)	0.43	60 (100)	0.49

Figures in parentheses indicate percentage to the respective totals

Nearly 68 per cent of beneficiary farmers owned land for cultivation while nearly 32 per cent had leased land for cultivation .The average leased in area of beneficiary farmers was worked out to be 0.54ha. Majority (55%) of the farmers in the head reach had cultivation in leased land. While in the middle reach 80 per cent were having owned land cultivation and the rest were with leased land. In the tail reach also, majority depended on owned land (80 %) for cultivation. Nearly 62 per cent of non-beneficiaries were cultivating on owned land and the rest 38 per cent had cultivation in leased land. Among the beneficiary farmers, the tendency to lease in was more in head reach. This may be due to the assured water supply from NIP.

4.1.1.3 Operated holding size

The details of the average operated area of the sample farmers are represented in the Table 4.1.It revealed that the average operated holding size is 0.51 ha for the beneficiary farmers. Among the beneficiaries, the middle reach farmers had a relatively larger operated holding size of 0.61ha. The non-beneficiaries had a relatively lower operated holding size. The operated holding size included the owned and leased in area used for cultivation excluding the barren and uncultivable land.

4.1.2 Family Size Status

Agriculture is labour intensive, and hence the involvement of family labour is significant. The data on the size and composition of family were collected and presented in Table 4.2

Table 4.2Average family size of respondents

(number per household)

Reaches	Average family size	Average Male members	Average female members
Head	3.9	2.00	1.9
Middle	3.8	2.00	1.75
Tail	3.34	1.85	1.65
Total beneficiaries	3.68	1.95	1.76
Total non beneficiaries	3.90	2.20	1.68

It was observed that the average family size beneficiaries of was 3.68. It consisted of 1.95 males and 1.76 females. There was no significant difference between the family size of the beneficiary farmers and non-beneficiary farmers on the one hand and among the head, middle and tail reach farmers on the other hand. Nuclear family was more prevalent and the joint family system was observed in a few cases only.

4.1.3 Labour Force Status

In farm management definition, all the family members in the age group of 16-59 years are included in this category. The break up of family members into children, old aged people and labour force are depicted in Table 4.3. The size of the labour force was same in upper, middle and tail reaches. There was no significant difference in the constitution of labour force among the head, middle and tail reach farmers.

Table 4.3 Average number of labour force per household

(number per household)

Stratum	Children	Members in labour force	Old age members
Head	1.15	2.40	0.40
Middle	0.80	2.40	0.70
Tail	0.40	2.05	0.95
Total beneficiaries	0.78	2.29	0.68
Total non beneficiaries	0.68	2.92	0.53

4.1.4 Working Force Status

Even though family members belonging to the age group 16-59 are available in a household to undertake agricultural activities, all of them may not participate in the farm operations directly. The opportunity cost of family labour will be high when alternate employment opportunities are available. This coupled with aversion to manual labour results in low participation of family members in farm operations. The details of the working force among respondents are presented in Table 4.4.

Table 4.4 Average working force per household

(number per household)

Stratum	Average work force
Head	1.40
Middle	1.40
Tail	1.20
Beneficiaries (Mean)	1.33
Non Beneficiaries	1.5

It could be seen that there was no significant difference in the size of the working force per household among the beneficiaries and non-beneficiaries on the

one hand, and among the head, middle and tail reach households on the other hand.

4.1.5 Educational Status

The educational level of the farm household members and the adoption of the modern cultivation practices are known to be positively related. The details of the educational attainment of the respondent households are presented in Table 4.5.

Table 4.5 Educational status of sample respondents

(number per stratum)

Category	Illiterates	Primary School	High School	Pre degree	Graduation	Post graduation	Total
Head	5 (25)	5 (25)	7 (35)	0 (0)	2 (10)	1 (5)	20 (100)
Middle	1 (5)	5 (25)	6 (30)	3 (15)	5 (25)	0 (0)	20 (100)
Tail	2 (10)	7 (35)	6 (30)	2 (10)	3 (15)	0 (0)	20 (100)
Beneficiaries	8 (13.33)	17 (28.33)	19 (31.67)	5 (8.33)	10 (16.67)	1 (1.67)	60 (100)
Non beneficiaries	9 (15)	20 (33.33)	21 (35)	2 (3.33)	7 (11.67)	1 (1.66)	60 (100)

Figures in parentheses indicate percentage to the respective totals

Among the beneficiary sample farmers, nearly 32 per cent were educated up to high school, while it was 35 per cent for the non-beneficiaries. From the non-beneficiary group, one each was educated up to post graduation. The proportion of farmers who were illiterate and educated up to primary school was

25 per cent each in the head reaches. Ten per cent were educated up to degree level and five per cent up to post graduation. For the respondents from the middle reach, illiterates were minimum (1%). While 25 per cent each were educated up to primary school and graduation, 30 per cent of them were educated up to high school. Ten per cent of the tail end farmers were illiterate. Among the non-beneficiaries, nearly 28 per cent were educated up to primary school, 20 per cent were illiterate and 35 per cent were educated up to high school. Fifteen per cent of the non-beneficiaries were illiterate.

4.1.6. Caste wise Distribution of the Sample Farmers

The details of caste wise distribution of sample farmers are furnished in Table 4.6. It revealed that majority of farmers (65 % - 75%) in the head reach and middle reach belonged to Nair community.

Table4.6 Caste wise distribution of sample farmers

(number per stratum)

Category	Nair	Christians	Ezhava	Scheduled Caste	Others	Total
Head	13 (65)	0 (0)	5 (25)	1 (5)	1 (5)	20 (100)
Middle	15 (75)	0 (0)	5 (25)	0 (0)	0 (0)	20 (100)
Tail	11 (55)	9 (45)	1 (5)	0 (0)	0 (0)	20 (100)
Beneficiaries	39 (65)	9 (15)	11 (18.33)	1 (1.6)	1 (1.6)	60 (100)
Non beneficiaries	25 (41.66)	20 (33.33)	5 (8.33)	8 (13.33)	2 (3.33)	60 (100)

Figures in parenthesis indicate per cent to total

Only five percent of the sample farmers in the head reach belonged to scheduled castes while their number was zero in middle and tail reaches. Eight per cent of the non-beneficiary farmers belonged scheduled caste category. Others include farmers from the Muslim community also. There was only one respondent who belonged to the Muslim community in the non-beneficiary group. The proportion of respondents who belonged to the Christian community was 15 per cent and 33 per cent respectively in beneficiary and non-beneficiary groups. They were mainly Nadar Christians.

4.1.7 Farming Status

Analysis of the farming status of sample farmers becomes relevant when the majority of the operators are marginal and small farmers. As the holding size diminishes, it becomes economically non-viable, compelling the operators to take up non-farm employment to supplement the farm income (Gasson, 1967, Haque, 1985, and Pingali, 1997). This leads to part time farming. The details of the farming status of the sample respondents are furnished in the Table 4.7.

Table 4.7 Farming status of the sample farmers

(Number per stratum)

Strata	Full time farmers	Part time farmers	Total
Head	12 (60)	8 (40)	20 (100)
Middle	12 (60)	8 (40)	20 (100)
Tail	14 (70)	6 (30)	20 (100)
Beneficiaries	38 (63.33)	22 (36.67)	60 (100)
Non beneficiaries	35 (58.33)	25 (41.66)	60 (100)

Figures in parentheses indicate percentage to the respective totals

Sixty three per cent of the beneficiary farmers were fulltime farmers while nearly 37 per cent were part time farmers. Sixty per cent farmers in the head and middle reaches were full time farmers while for the tails reach it was marginally high (70%). Only 40 per cent of the farmers in the head and middle reaches were part time farmers. For the tail reach the part time farmers constituted 30 per cent. Among the non-beneficiaries nearly 58 per cent were full time farmers, and 42 per cent were part time farmers.

4.1.8 Economic Status

The farming status, i.e., whether the operators belong to the category of part time or full time farmers will influence their income pattern, thereby economic status also. In the study, a farmer who derives his income from farming alone is treated as a full time farmer. Table 4.8 reveals the income pattern of sample respondents in each stratum.

Table 4.8 Economic status of the sample farmers

(Rs./ house hold)

Stratum	Gross agricultural income	Gross non-agricultural income	Gross income
Head	173355 (87.62)	24500 (12.38)	197855 (100.00)
Middle	180955 (81.67)	40615 (18.33)	221570 (100.00)
Tail	109473 (68.66)	49500 (31.14)	158973 (100.00)
Total Beneficiaries	106153 (73.10)	39057 (26.90)	145210 (100.00)
Non Beneficiaries	98629 (63.52)	56643 (36.48)	155272 (100.00)

Figures in parentheses indicate percentage to the respective totals

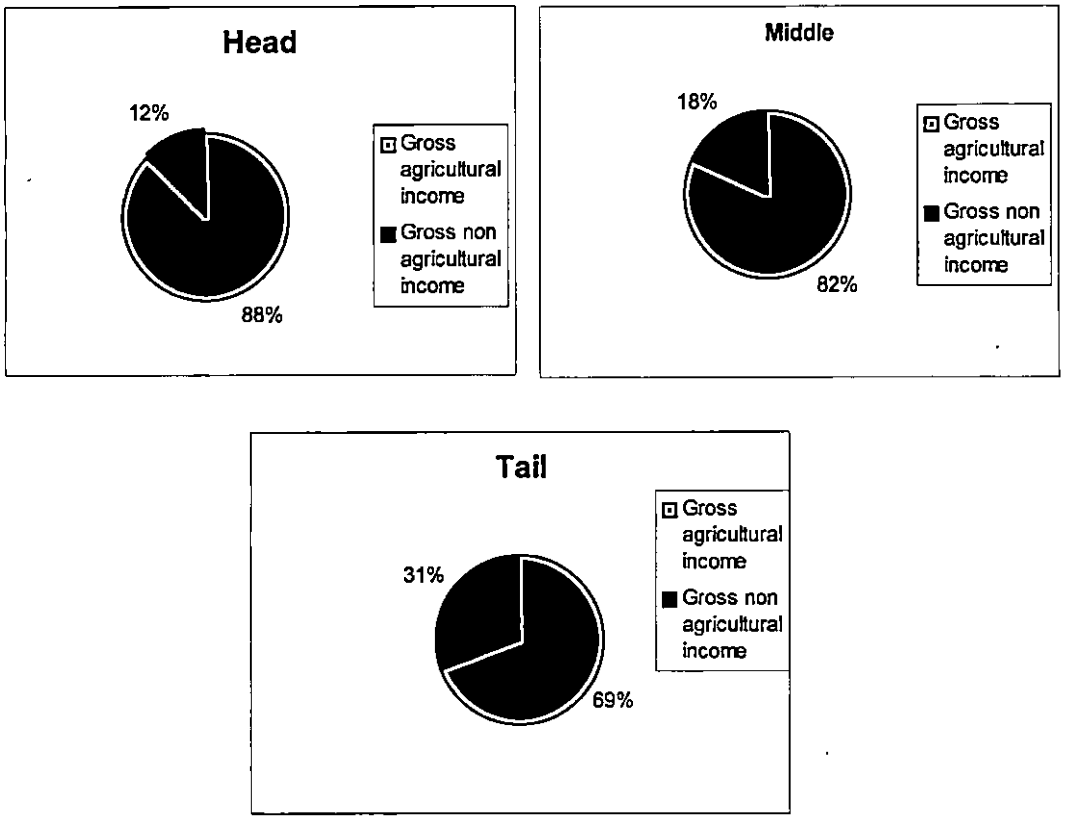

Fig 4.1 Economic status of sample farmers

It can be observed that the gross income from agriculture was more for beneficiary farmers (Fig 4.1). Nearly 73 per cent of the gross income was contributed by agriculture for the beneficiaries and it was nearly 63 per cent for non-beneficiaries. For the head reach and middle, the contribution of agricultural income was 88 per cent and 82 percent in that order, indicating greater dependency of these farmers on farming. Income from non-agricultural activities was the highest for the non-beneficiary farmers.

4.1.9Cropping Pattern in Operated Holding

Cropping pattern is the proportion of area under different crops in a farm at a point of time. The details of cropping pattern of the respondent farmers are presented in Table 4.9.

Table 4.9.Cropping pattern in operated holding (ha)

Strata	Head	Middle	Tail	Beneficiaries	Non Beneficiaries
Banana	0.20 (33.33	0.29 (38.67)	0.19 (38.78)	0.22 (37.29)	0.19 (35.19)
Coconut	0.12 (20.00)	0.10 (13.33)	0.09 (18.37)	0.10 (16.95)	0.14 (22.22)
Tapioca	0.09 (15.00)	0.12 (16.00)	0.08 (16.33)	0.09 (15.25)	0.07 (16.67)
Vegetables	0.16 (26.67)	0.21 (28.00)	0.10 (20.41)	0.15 (25.42)	0.10 (18.52)
Paddy	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0.02 (3.70)
Arecanut	0.02 (1.67)	0.02 (2.67)	0.01 (2.04)	0.02 (3.39)	0.01 (1.85)
Others	0.01 (1.67)	0.01 (1.33)	0.02 (4.08)	0.01 (1.69)	0.02 (1.85)
Total	0.60 (100.00)	0.75 (100.00)	0.49 (100.00)	0.59 (100.00)	0.54 (100.00)

Figures in parenthesis indicate per cent to total

It can be seen that maximum area was occupied by banana crop (35.37%). This was followed by coconut (13-22%) Tapioca occupied 15 to 17 per cent of the total cropped area. The share of vegetables was higher for head and middle reach farmers as compared to tail reach farmers. Thus it can be concluded that while the head and middle reach farmers devoted more cropped area under more water demanding cash crops, the tail reach farmers gave relatively less thrust on water demanding crops.

4.1.10 Farm Investments Pattern

The farm investment pattern is an approximate reflection of the net capital accumulation in a farm. The details of the farm investment pattern of the respondent farmers are presented in Table 4.10. The farm investments were valued at their book value. It was estimated by deducting the annual depreciation from the purchase price or installation cost (as the case may be).

Table 4.10 Farm investment pattern

(Rs/household)

Strata	Farm buildings	Equipments and machinery	Irrigation system	Livestock	Total
Head	4450 (16.94)	1586 (6.04)	4058 (15.45)	16172 (61.57)	26266 (100.00)
Middle	5929 (16.15)	1396 (3.80)	6975 (19.00)	22416 (61.05)	36716 (100.00)
Tail	5439 (17.26)	1806 (5.73)	7949 (25.22)	16323 (51.79)	31517 (100.00)
Beneficiary	5373 (17.36)	1596 (5.16)	5634 (18.20)	18345 (59.28)	30948 (100.00)
Non beneficiary	5675 (12.81)	1588 (3.58)	20139 (45.46)	16896 (38.14)	44298 (100.00)

Figures in parentheses indicate percentage to the respective totals

Total farm investments per household were more for non-beneficiary farmers as compared to the beneficiary farmers. They had invested more on the irrigation related investments. The main item of the farm investment among the beneficiary farmers was investment on livestock (59.28%). Among the beneficiary farmers, the investment on irrigation was more for the tail reach farmers. The beneficiaries in general and head and middle reach farmers in particular had less investment on irrigation system because of the availability of water from NIP. The tail reach farmers and the non-beneficiaries were on the other hand, subjected to more water scarcity, and hence invested more on developing other water sources. Other investments consist of equipments, machinery (4-6%) and farm building (12- 17%).

4.1.11 Source Wise Irrigation

Details on source wise irrigation is given in the Table 4.11.It is clear that the dependence on canal is 100 per cent for the head and middle reach farmers. All the farmers from head reach depended on canal. Two of them depended on wells also. They depended on canal water as an assured source of irrigation round the year. The head reach farmers were always getting water from the canal because the shutters of the dam were not properly maintained. They depended on other sources of irrigation also but the dependence was low.

Table.4.11 Number of farmers depending on different sources of irrigation

		Source of irrigation			
Sl No	Strata	Canal	Well	Pond	Others
1	Head	20 (100)	2 (10)	0 (0)	0 (0)
2	Middle	20 (100)	4 (20)	0 (0)	0 (0)
3	Tail	13 (65)	18 (90)	9 (45)	0 (0)
4	Non beneficiaries	0 (0)	39 (65)	9 (15)	14 (23.33)

Figures in parenthesis indicate percentage to respective totals

The tail reach farmers were not getting water round the year. Therefore, they depended more on wells and ponds. One main pond was cleaned for irrigation purpose for the farmers by CADA. However, they use the available water from the canal whenever water is released. Dependence on canal water was only 65 per cent for the tail reach farmers. Even though they were members of BFA, canal was not the main source of irrigation for them.

For the non-beneficiaries, the main source of irrigation was open dug wells (65 %). Nearly 24 per cent non-beneficiaries depended on other sources like *Panchayat* owned common ponds. The dependence on privately owned ponds was only 15 per cent.

4.1.12 Cropping Intensity

The cropping intensity shows the intensity with which cropped land is subjected to cultivation. The cropping intensity of the sample farmers are presented in the Table 4.12

Table 4.12Area irrigated in the farm and the cropping intensity

Strata	Net Sown Area *(ha)*	Gross Sown *area* (ha)	Cropping *Intensity* (%)	Irrigated area (%)	Irrigated area as per cent to gross sown area
Head	0.50	0.60	120.00	0.50	83.33
Middle	0.61	0.75	122.95	0.61	81.33
Tail	0.43	0.49	113.95	0.39	79.59
Beneficiaries	0.51	0.59	115.68	0.48	81.35
Non beneficiaries	0.41	0.54	110.20	0.43	79.62

The cropping intensity of the farmers varied from 110 to 123 per cent. The cropping intensity of the beneficiary farmers were slightly higher than that of non beneficiary farmers. Among the beneficiaries, the cropping intensity was highest among the middle reach farmers (122.95), followed by head reach (120.00) and tail reach farms (113.95). The higher cropping intensity of the middle reach farmers is due to more area under vegetable cultivation. The share of the perennial and annual crops together accounted for 72 per cent cropped area in the middle reach, leaving 28 per cent for the seasonal crops. The area under seasonal crops in the head and tail reaches were 26.67 and 20.41 per cent respectively. This resulted in lower cropping intensity in these reaches. Such increase in cropping intensity due to irrigation development was reported by Shrivastava *et al.* (1991), Vekariya (1997), Azam (1998), Karunakaran and Palaniswamy (1998) and Narayanamoorthy (2001).

In general, about 80 per cent or more of the cropped area were brought under irrigation in all the strata. Non-beneficiary farmers who were not at all benefited by canal irrigation had developed alternate sources like wells and ponds.

4.2 OPERATIONAL EXPENSES ON MAJOR CROP ENTERPRISE

The major crop enterprise for the sample farmers was banana, coconut, tapioca, rice and vegetables. The operational expenses on the above crops in different strata were estimated and presented subsequently.

4.2.1 Operational Expenses on Banana

Operational expenses incurred by various strata of farmers on banana (*Musa spp.*) are depicted in Table 4.13.The popular variety among the farmers was *Nendran.* The major item of operational expenses incurred by the beneficiary farmers was on organic matter. It accounted for nearly 30 per cent of the total operational expenses. It included mainly cow dung followed by wood ash, neem

cake, compost etc. Human labour (including both hired and family labour) formed just nearly 27 per cent of operational expenses (Fig. 4.2).

Table 4.13 Operational expenses on banana

(Rs/std ha)

Particulars	Head	Middle	Tail	Beneficiaries	Non Beneficiaries
Human labour	20808.11 (20.45)	23443.43 (27.24)	28145.83 (39.70)	23675.00 (26.80)	34115.17 (37.27)
Planting material	5887.83 (5.79)	5683.65 (6.61)	6236.11 (8.80)	5910.19 (6.69)	5889.57 (6.43)
Organic Manure	36171.35 (35.54)	22955.5 (26.68)	15472.71 (21.83)	26087.35 (29.53)	21707.95 (23.72)
Chemical Fertiliser	8569.89 (8.42)	8290.85 (9.64)	7981.41 (11.26)	8316.54 (9.41)	7100 (7.76)
Plant protection chemicals	412.41 (0.41)	404.83 (0.47)	464.58 (0.66)	423.7 (0.48)	574.4 (0.63)
Fuel charges	143.2 (0.14)	434.32 (0.50)	600.93 (0.85)	600.93 (0.68)	1400.66 (1.53)
Lease	19487.06 (19.15)	17634.53 (20.49)	4456.25 (6.29)	14839.04 (16.80)	11642.22 (12.27)
Staking	9807.16 (9.64)	6729.22 (7.82)	7097.22 (10.01)	8021.48 (9.08)	8070.76 (8.82)
Machinery hiring charges	0 (0)	0 (0)	0 (0)	0 (0)	254.10 (.28)
Lime	477.32 (0.47)	471.85 (0.55)	434.03 (0.61)	463.89 (0.53)	770. 60 (0.84)
Total	101764.33 (100.00)	86048.18 (100.00)	70889.07 (100.00)	88338.12 (100.00)	91525.43 (100.00)

Figures in parenthesis indicate per cent to total

There was no major difference in the labour use pattern in the head, middle and tail reach farmers, but differences existed in wage rate. This explains the difference in expenditure on labour use. The next major item of expenditure

was the rental value on leased land. The share of chemical fertilisers and staking materials were around nine per cent. The expenditure on plant protection chemicals (ppc) and soil ameliorants were negligible.

Among the beneficiaries, head reach farmers followed by middle and tail reach farmers incurred the highest operational expenses. Organic manure constituted the bulk of the cost (35.54 %) of the head reach farmers. This was followed by human labour (20.45%). For the middle and tail reach farmers, human labour constituted the bulk of the expenditure. Farmers in the head reach incurred more on staking material followed by farmers in the tail and middle regions in that order. This difference was because of the difference in plant density in the three reaches. The plant density in the head reach was higher (1976 plants per standard hectare) while it was the lowest for the middle reach farmers (1895 plants per standard hectare). The plant density among the tail reach farmers was higher than that of middle reach farmers but lower than that of head reach farmers (1975 plants per hectare). Other items of expenditure included cost of planting materials, fuel charges, soil ameliorants like lime and plant protection chemicals. Only non-beneficiaries incurred the machinery hiring charges, as the practice of hiring farm machinery and implements was more prevalent in the area like Vellayani.

The agro techniques in the Thembamuttom, Pezhoorkonam and Thumbottukonam *Karshaka Samithi* area in the upper and middle reaches were more standardised and superior due to the presence of field centre of Vegetable and Fruit Promotion Council, Keralam (VFPCK) located at Thembamuttom. It was one of the best field centres of Kerala. A well-established marketing yard was there. The farmers could get necessary technical assistance, needed inputs and good marketing facility from the field centre.

The details of yield per hectare of banana are presented in Table 4.14. The yield of non-beneficiaries was lower than that of beneficiary farmers.

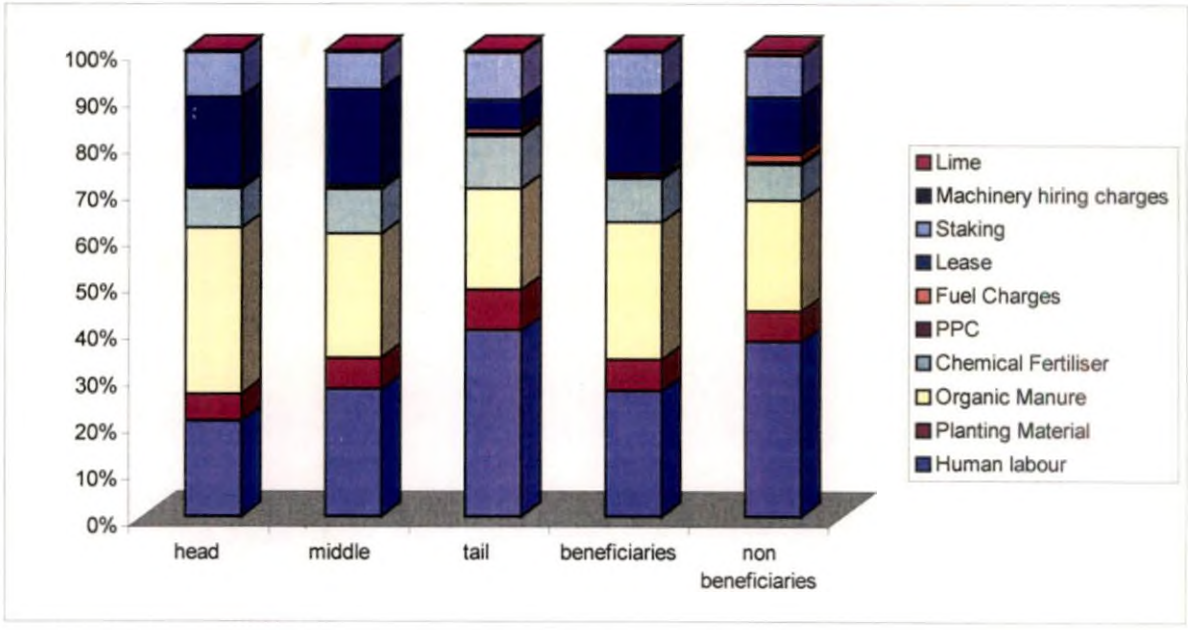

Fig. 4.2 Operational expenses on banana

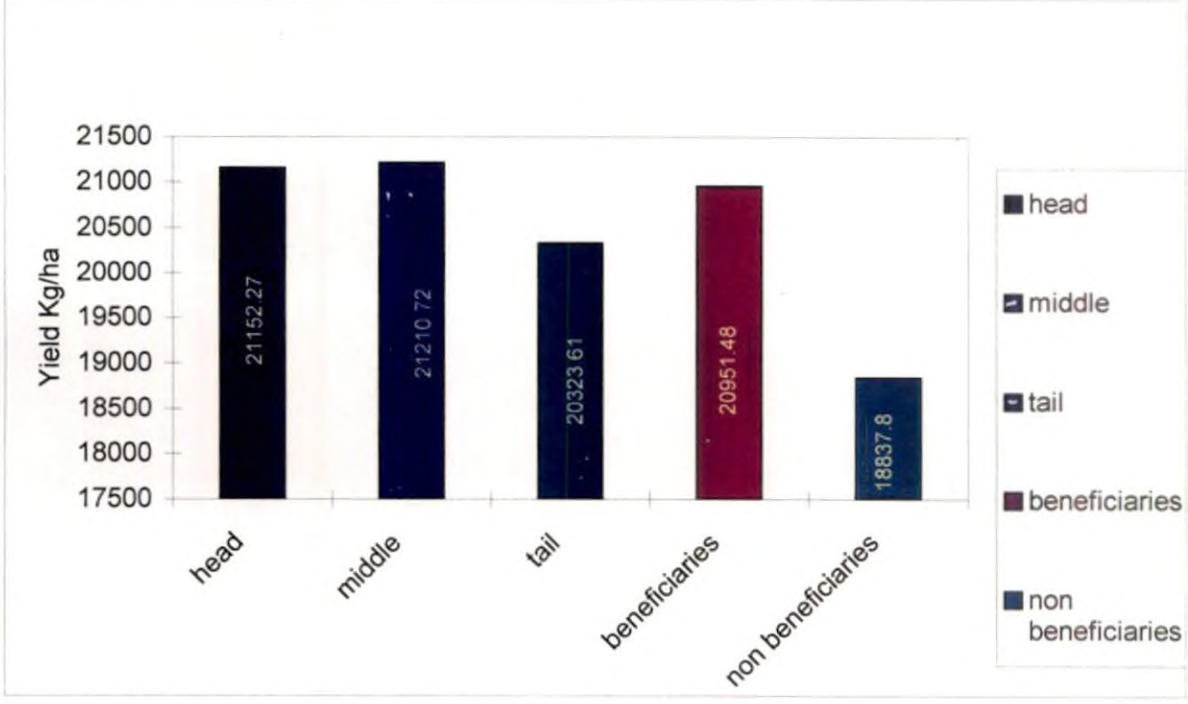

Fig. 4.3 Yield of banana per hactre

Among the beneficiary farmers the yield of banana in the head and middle reaches were relatively higher than that of tail reach farmers (Fig 4.3). It is statistically significant also. This is the reflection of the better agro techniques being translated into higher productivity. High crop productivity on account of irrigation input and resultant higher farm income was reported by Dinkar (1990) and Regmi *et al.* (2000).

Table 4.14 Yield of banana from the sample area

Strata	Yield (Kg/ ha)	Yield (kg/plant)
Head	21152.27*	10.70
Middle	21210.72*	11.19
Tail	20323.61*	10.29
Beneficiaries (total)	20951.48	10.72
Non Beneficiaries	18537.80	9.42

*Significant at 5% level of significance

The gross margin worked out as the surplus of gross income over the operational expenses was also more for the beneficiaries as compared to the non-beneficiaries (Table 4.15). As already explained, the gross margin of the head and middle reach farmers was higher than that of tail end farmers. The gross margin of the head and middle reach farmers were statistically significant from that of the non beneficiaries, while that of tail reach and non beneficiary farmers were statistically non significant. It indicated that the head and middle reach farmers could translate the agronomic advantage to economic advantage more effectively.

Table 4.15 Gross income and gross margin on banana

(Rs/std ha)

Strata	Gross income	Gross margin
Head	309718.38*	207954.04
Middle	301216.09*	218160.94
Tail	259983.33NS	188212.56
Beneficiaries	293519.26	20324.81
Non beneficiaries	251102.35	159576.90

*Significant at 5% level of significance

NS- Non significant

4.2.2 Operational Expenses on Coconut

Coconut (*Cocos nucifera)* was another important crop grown in the command area. The operational expenses on coconut are depicted in Table 4.16. Among the beneficiaries, the highest operational expenses were incurred by head reach farmers (Rs14799.9) followed by middle (Rs14097.29) and tail reach farmers (Rs13603.1) in that order. For the head reach farmers nearly 54 per cent of the total operational expense was incurred by expenditure on organic manure followed by human labour (42 %). The middle reach farmers also followed the same pattern with 51 per cent expense on human labour and nearly 45 per cent on organic manure. In general, coconut growers gave preference for organic manures in place of chemical fertilisers. For the tail reach farmers, the most expensive item of cultivation was human labour followed by expenditure on organic manure. The beneficiaries, in general spent nearly 51 per cent on organic manure and 46 per cent on human labour. In general, non-beneficiaries gave less emphasis to organic manure and used human labour more intensively. The chemical fertilisers and lime constituted negligible amount for both beneficiaries and non-beneficiaries though beneficiaries used marginally higher quantity. The pattern of operational expenses is depicted in Fig 4.4.

Table 4.16 Operational expenses on coconut

(Rs/ std ha)

Particulars	Head	Middle	Tail	Beneficiaries	Non beneficiaries
Human labour	6154.04 (41.58)	6449.17 (45.75)	6914.72 (50.83)	6493.52 (45.92)	6783.87 (56.10)
Organic manure	7989.21 (53.98)	7169.35 (50.86)	6322.25 (46.48)	7154.33 (50.59)	5007.51 (41.41)
Fertilisers	530.82 (3.59)	299.15 (2.12)	236.36 (1.74)	337.71 (2.39)	214.32 (1.77)
PPC	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lime	125.83 (0.85)	179.62 (1.27)	129.77 (0.95)	155.05 (1.10)	86.63 (0.72)
Total operational expenses	14799.9 (100.00)	14097.29 (100.00)	13603.1 (100.00)	14140.61 (100.00)	12092.33 (100.00)
Expenses per palm	84.57	80.55	77.73	80.80	60.09

Figures in parentheses indicate per cent to respective totals

The yield of coconut on per hectare basis and per palm basis is depicted in Table 4.17. In general, beneficiaries had higher yield compared to non-beneficiaries (4.80% higher). Among the beneficiaries, yield per hectare of coconut was the highest among the head reach farmers (9806.18 nuts / ha/ year) followed by middle reach palms (9684.87nuts / ha/ year). It is statistically significant also. The tail reach farmers and the non-beneficiaries could get only 9157.1 and 9146.33 nuts per ha / year in that order (Fig 4.5). There mean yield was statistically not different from that of the non-beneficiaries. Coconut is a crop that responds well to irrigation. Although the cultivation was conventional for both beneficiaries and non-beneficiaries, better water availability in the head and middle reaches resulted in higher yield in the head and middle reaches. As water availability was not assured in the tail region, these farmers experienced water shortage in the summer months. This was the major reason for the lower yield recorded in the tail region.

Table 4.17 Yield of coconut in the command area

Strata	Yield (Nuts /std ha/year)	Yield (Nuts/palm/year)
Head	9806.18*	56.03
Middle	9684.87*	55.34
Tail	9157.1NS	52.32
Beneficiaries	9589.09	54.77
Non beneficiaries	9146.33	52.26

*Significant at 5% level of significance

NS- Non significant

Consequently, gross margin was higher for beneficiaries (Rs 44157.45) as compared to non-beneficiaries (Rs 32065.12). Among the beneficiaries, higher gross margin was realised by the head reach farmers (Rs 39736.99), followed by the middle reach farmers (Table 4.18). It is statistically significant also. The tail reach farmers and the non- beneficiaries had a lower gross margin.

Table 4.18. Gross income and gross margin in coconut

(Rs/std ha)

Strata	Gross income	Gross margin
Head	54536.89*	39736.99
Middle	51048.68*	36951.38
Tail	48168.27NS	34465.17
Beneficiaries	51135.95	44157.45
Non beneficiaries	47995.34	32065.12

*Significant at 5% level of significance

NS-Non significant

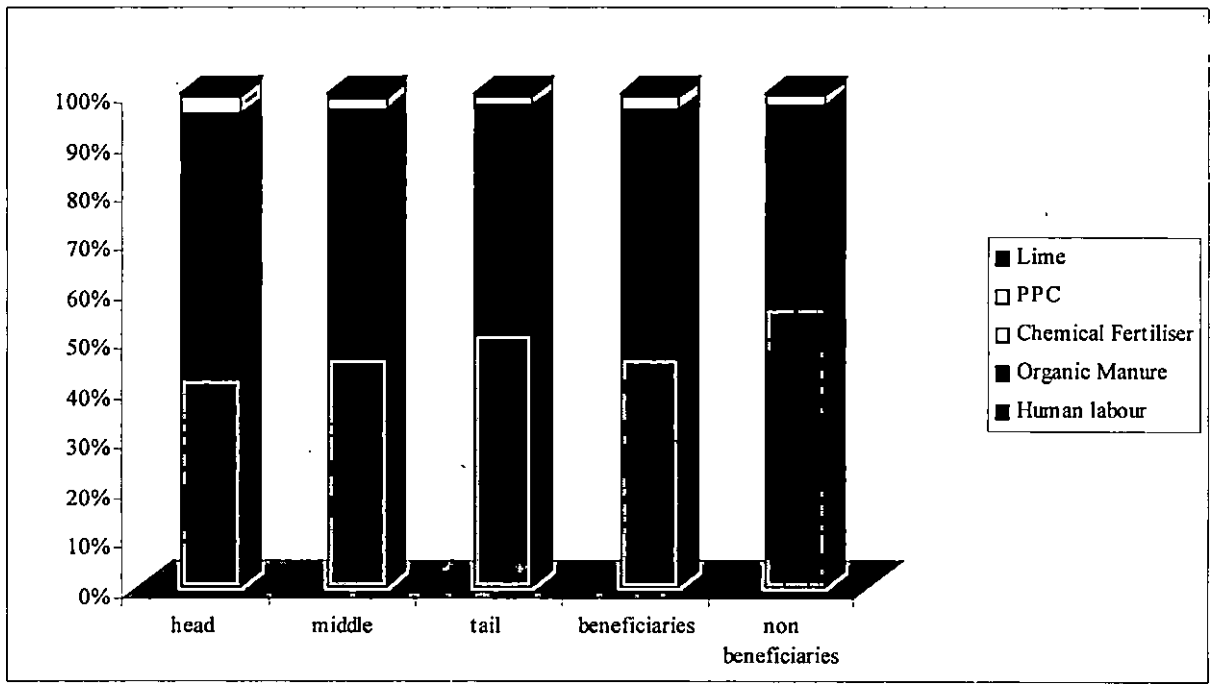

Fig. 4.4 Operational expenses on Coconut

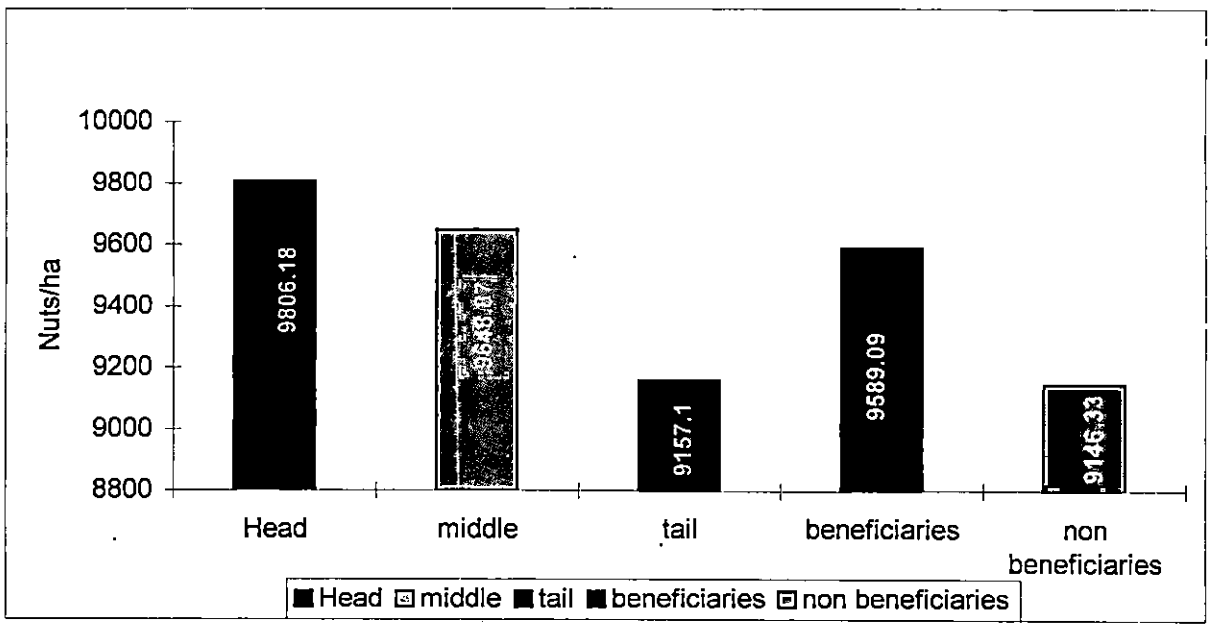

Fig 4.5 Yield of Coconut (Nuts/Year/ha)

4.2.3 Operational Expenses on Tapioca

Tapioca was grown mostly as a rainfed crop in Kerala. However, the operational expenses on tapioca were also tabulated. The operational expenses of tapioca (Table 4.19) did not differ significantly between the beneficiaries and non-beneficiaries.

Table 4.19 Operational expenses on tapioca

(Rs/ha)

Particulars	Head	Middle	Tail	Beneficiaries	Non beneficiaries
Seeds	1422.02 (3.17)	1436.78 (3.35)	1398.10 (3.43)	1412.77 (3.34)	1473.3 (3.56)
Human labour	26600.92 (59.33)	26724.14 (62.27)	28933.65 (71.08)	27836.60 (65.81)	31266.99 (75.53)
Organic manure	11238.58 (25.07)	9482.86 (22.09)	5142.18 (12.63)	7702.70 (18.21)	4199.02 (10.14)
Fertilisers	5412.84 (12.07)	5118.39 (11.93)	5100.00 (12.53)	5187.71 (12.26)	4290.15 (10.36)
PPC	160.55 (0.36)	155.17 (0.36)	158.77 (0.39)	158.48 (0.37)	165.05 (0.40)
Lease	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total operational expenses	44834.91 (100.00)	42916.74 (100.00)	40732.73 (100.00)	42298.26 (100.00)	41394.51 (100.00)

Figures in parentheses indicate per cent to respective totals

For the beneficiaries, nearly 66 per cent of the total operational expenses were contributed by human labour. Organic manure contributed 18.21 per cent. Among the beneficiaries tail reach farmers incurred maximum expenses on human labour (71.03%) compared to head reach (59.33%) and middle reach farmers (62.27%). In general, the head reach farmers incurred maximum operational expenses (Rs 44834.91) when compared to non-beneficiaries (Rs 41394.51) and other reach farmers. The expenses on rodenticide (ppc) were negligible.

There was not much difference in the yield realised in the head, middle and tail reach farmers on the one hand; between the beneficiaries and non-beneficiaries on the other hand (Table 4.20).

Table 4. 20 Yield per hectare in tapioca (Kg per hactre)

Strata	Yield
Head	15564.22
Middle	15117.24
Tail	14770.14
Beneficiaries	15057.00
Non beneficiaries	15084.95

The beneficiary farmers had a marginally higher gross margin than the non-beneficiaries (Table 4.21). The gross margin of the head and middle reach farmers were comparable while that of tail reach farmers were relatively lower.

Table 4.21 Gross income and gross margin in tapioca

(Rs/ha)

Strata	Gross income	Gross margin
Head	58067.43	13248.07
Middle	56066.21	13164.64
Tail	49484.38	8780.45
Beneficiaries	41205.33	10890.2
Non beneficiaries	53391.99	12032.53

4.2.4 Operational Expenses on Vegetables

Most of the farmers were growing vegetable as an inter crop in the banana garden. Only a few were growing it as sole crop. Culinary melon, amaranth and

snake gourd were the main vegetables cultivated. The rent on leased in land was not included because the vegetables were mostly grown as an intercrop in the area. The pattern of operational expenses did not show much difference among the farmers. The operational expenses were worked out and discussed separately.

4.2.4.1 Culinary melon

Culinary melon (*Cucumis melo*) was mostly grown as an inter crop in banana garden. The total operational expenses were the highest among the middle reach farmers (Rs 40820.42) followed by head reach farmers (Rs 37552.5) and non-beneficiaries. Use of organic manure was more prevalent among the beneficiaries (32.77%) compared to non-beneficiaries. Among the beneficiaries, the head reach farmers used relatively more organic manure (33.75%). The use of ppc was prevalent among the farmers irrespective of whether they were beneficiaries or non-beneficiaries. The rental value was not considered because vegetables were grown as an intercrop in the banana. The details are presented in Table 4.22.

Table 4.22. Operational expenses on culinary melon

(Rs/ha)

Particulars	Head	Middle	Beneficiaries	Non beneficiaries
Seeds	1120 (3.00)	1232.14 (3.02)	1161.22 (3.00)	1052.78 (2.94)
Human labour	19500 (51.9)	21875 (53.59)	20459.18 (52.93)	21388.89 (59.65)
Organic manure	12645 (33.7)	13135.71 (32.18)	12667.34 (32.77)	9919.44 (27.67)
Fertilisers	2125 (5.7)	2142.86 (5.25)	2091.84 (5.41)	1450.00 (4.04)
Staking and pandal	0 (0)	0 (0)	0 (0)	0 (0)
PPC	2162.5 (5.80)	2434.71 (5.96)	2273.92 (5.88)	2044.17 (5.70)
Total operational expenses	37552.5 (100.00)	40820.42 (100.00)	38653.50 (100.00)	35855.28 (100.00)

Figures in parentheses indicate per cent to total

Details on yield per hectare, gross income and gross margin are depicted in Table 4.23. The yield per hectare was the highest for the middle reach farmers (155887.57Kg/ha). The head reach farmers come next (14766.25 kg/ha). As expected the non beneficiaries had a relatively lower yield of 13717.58 kg/ha.

Table 4.23 Yield per hectare gross income and gross margin of culinary melon

Strata	Yield (Kg /ha)	Gross income (Rs/ha)	Gross margin (Rs/ha)
Head	14766.25	59065.00	21512.5
Middle	15887.57	63550.00	22729.57
Beneficiaries	15105.65	60422.44	21768.93
Non beneficiaries	13717.58	54870.33	19015.06

In all the crops discussed so far, the head reach farmers had a higher yield level except in the case of banana. Here the head reach had a lower crop yield. The crop is trailed on ground. Because of continuous wetting and higher moisture regime fruit rot was more prevalent in the head reach .As a result the head reach farmers incurred more loss. Due to this problem, there is a tendency to stop culinary melon cultivation in the head reach area. This problem was not so pronounced in the middle reach and tail reaches.

4.2.4.2 Amaranth

The operational expenses in amaranth (*Amaranthus* spp.) are depicted in Table 4.24. For both beneficiaries and non-beneficiaries, labour cost formed 64-66 per cent of the total operational expenses. This was followed by the expenses on organic manure (18 %). The operational expense was the highest among the head reach farmers. Among the beneficiaries, the middle reach farmers used more organic manures. Seeds and ppc come next.

Table 4.24 Operational expenses in amaranth

(Rs/ha)

Particulars	Head	Middle	Tail	Beneficiaries	Non beneficiaries
Seeds	2733.31 (6.63)	2657.5 (6.50)	2344.90 (6.11)	2528.46 (6.36)	2620.38 (7.02)
Human labour	26538.46 (64.41)	26250.00 (64.19)	25375.00 (66.09)	25914.63 (65.16)	24062.50 (64.46)
Organic manure	7701.00 (18.69)	8166.63 (19.97)	7116.65 (18.54)	7507.10 (18.88)	7015.63 (18.83)
Fertilisers	2492.31 (6.05)	2237.50 (5.47)	1995.00 (5.20)	2200.00 (5.53)	2062.50 (5.53)
Staking and Pandal	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
PPC	1733.54 (4.21)	1579.50 (3.86)	1561.65 (4.07)	1619.63 (4.07)	1554.50 (4.16)
Total operational expenses	41199.54 (100.00)	40891.13 (100.00)	38393.2 (100.00)	39769.82 (100.00)	37329.38 (100.00)

Figures in parentheses indicate per cent to total

In general, yield per hectare of amaranth was maximum for head reach farmers followed by middle and tail reach farmers. The water requirement and water use efficiency is more in amaranth due to frequent harvesting followed by flushing. The farmers took four to five cuttings. Head reach farmers were having the advantage of ample water availability and consequently they were realising a higher crop yield. Gross income and gross margin was the highest for the beneficiaries in general and head reach farmers in particular (Table 2.25).

Table 2.25 Yield per ha gross income and gross margin of amaranth

Strata	Yield (Kg/ha)	Gross income (Rs/ha)	Gross margin (Rs/ha)
Head	16326.77	81633.85	40434.31
Middle	15579.13	77895.63	37007.50
Tail	14137.65	70658.25	32265.06
Beneficiaries	15110.09	75550.48	35780.65
Non beneficiaries	14060.63	70333.13	33003.75

4.2.4.3 Snake gourd

Snake gourd *(Trichosanthes cucumerina)* was grown as a sole crop in *Pandal* system. Both the beneficiaries and non-beneficiaries had almost the same pattern of expenses (Table 4.26). However, beneficiaries in general incurred relatively higher operational expenses as compared to non-beneficiaries. Human labour constituted nearly 46 per cent of the total operational expenses for both beneficiaries and non-beneficiaries. Expenses on staking and pandal making (19-22%) were the next main item of expenditure. Expenses on other inputs showed more or less a similar trend.

Table 4.26. Operational expenses on snake gourd

(Rs/ha)

Particulars	Middle	Tail	Beneficiaries	Non beneficiaries
Seeds	972.22 (1.13)	991.67 (1.18)	977.08 (1.14)	937.50 (1.12)
Human labour	38888.89 (45.06)	40833.33 (48.53)	39375.00 (45.91)	38645.83 (46.12)
Organic manure	18055.56 (20.92)	16637.17 (19.77)	17700.96 (20.64)	16458.33 (19.64)
Fertilisers	6166.67 (7.15)	5387.77 (6.40)	5971.79 (6.96)	5331.58 (6.36)
Pandal and staking	18550.00 (21.49)	16705.00 (19.85)	18088.75 (21.09)	18700.00 (22.32)
PPC	3666.67 (4.25)	3588.33 (4.26)	3647.08 (4.25)	3716.67 (4.44)
Total operational expenses	86300.01 (100.00)	84143.27 (100.00)	85760.66 (100.00	83789.91 (100.00)

Figures in parentheses indicate per cent to total

Yield per hectare was more for beneficiaries than the non beneficiary farmers (Table 4.27). Gross income and gross margin showed similar trend with middle reach farmers having more gross income and gross margin compared to tail reach farmers and non beneficiaries.

Table 4.27.Yield per hactre, gross income and gross margin in snake gourd

Strata	Yield (Kg /ha)	Gross income (Rs/ha)	Gross margin (Rs/ha)
Middle	13791.67	96541.67	10241.67
Tail	13039.33	91275.33	7132.67
Beneficiaries	13603.58	95225.02	9464.42
Non beneficiaries	12958.25	90707.75	6876.17

4.2.5.Operational expenses on paddy

The shift in cropping pattern happening in the command area is characterised by a shift mainly from paddy to crops like banana, coconut, vegetables and tapioca. A general observation is that paddy as a crop is becoming less popular among the farmers in the command area on account of its lower relative profitability. It is against this background that the cost and returns of paddy cultivation is being analysed and presented. The beneficiary farmers were not having paddy in their cropping pattern. Only the non-beneficiary farmers were having paddy cultivation. However, the cost of cultivation of the farmer having paddy cultivation is tabulated.

Operational expenses on paddy are depicted in the Table 4.28. Human labour contributed 60 per cent of total operational expenses of paddy cultivation. This was followed by expenses on organic manure (14.33%) and fertiliser application (7.36%). Use of animal power for land preparation was non-existent in

the area. Machinery hiring included hiring tractor, tiller etc. It was paid on hourly basis and formed nearly 10 per cent of the operational expenses.

Table 4.28 Operational expenses on paddy

Particulars	Rs/ha
Seeds	941.18 (3.35)
Human Labour	16862.75 (60.00)
Organic Manure	4027.45 (14.33)
Fertiliser	2069.61 (7.36)
Machinery hiring charge	2843.14 (10.12)
PPC	1362 (4.85)
Total	28106.86 (100.00)

Figures in parentheses indicate per cent to total

Yield per hectare of paddy was 3108 kg/ha. The farmers got fairly reasonable yield. The gross income by considering the income from grain as well as straw yield was worked out to be Rs39651.96 leaving a gross margin of Rs 11545.10/ha. As leasing was very prevalent in the area and since the respondents were tenant cultivators, the gross margin by considering land rent (Rs 5000/ ha) reduced the gross margin to Rs 4991.18 / ha. Thus it can be seen that the gross margin was the lowest for paddy among all the crops considered in the command area. Paddy cultivation in the area had additional problems like non-availability of labourers. The labours are reluctant to work in wetland when compared to other dry land crops.

Table 4.29 Yield per ha, gross income and gross margin of paddy

Yield (Kg /ha)	Gross income (Rs)	Gross margin (Rs)
3107.84	38098.04	38098.04*
	9991.18*	4991.18*

*Rental value on leased land excluded

4.3 ACTUAL UTILISATION INDEX

Actual utilisation index (AUI) indicates the irrigated area as a percentage to the targeted irrigated area. The cumulative achievement at the end of various years is given in the Table4.30.

Table 4.30. Cumulative achievement at the end of various years

Year	Actual irrigated area (ha)	Targeted irrigated area(ha)	AUI (%)
1985	8615	16042	53.70
1995	10528	16042	65.63
2001	10528	16042	65.63
2003	12013	16042	74.88

Source: Department of Irrigation, Thiruvananthapuram

It is clear that the cumulative area actually brought under irrigation had increased over the years from 8615 ha in 1985-86 to 12013 ha by 2003. The AUI shows that even though the actual irrigated area increased in absolute terms, it still accounts for only 75 per cent of the targeted area only. It was indicative of the low utilisation of the irrigation potential created.

4.4 RAINFED BASED YIELD INDEX (RBYI)

RBYI gives an idea about the contribution of irrigation to crop productivity. It is estimated by relating the irrigated yield to the average rainfed yield in the same area. The RBYI of the important crops in the command area is estimated and presented below.

4.4.1RBYI of Paddy

It can be noted from Table 4.31 that average productivity of irrigated paddy was 24 per cent more than that of average productivity in the district.

Table 4.31 RBYI of paddy

No	Year	Productivity in the ayacut	Productivity for the district	RBYI
1	1985-86	2736	2374	1.15
2	1986-87	2099	2102	0.99
3	1987-88	2326	2000	1.16
4	1988-89	2887	2465	1.17
5	1989-90	2956	2650	1.11
6	1990-91	2729	2417	1.12
7	1991-92	3420	2459	1.39
8	1992-93	3605	2429	1.48
9	1993-94	3707	2512	1.47
10	1994-95	3340	2352	1.42
Mean		2981	2406	1.24

Source CADA, Neyyattinkara

It can also be noted that except for the year 1986-87, the RBYI was more than one thereby indicating that irrigation contributed to higher crop productivity in paddy.

4.4.2. RBYI of Coconut

The RBYI of coconut is estimated and shown in Table 4.32

Table 4.32.RBYI on Coconut

Sl No	Year	Yield in Ayacut (No/ha)	Yield in district (No/ha)	RBYI
1	1985-86	9753	4651	2.10
2	1986-87	9519	4541	2.10
3	1987-88	8586	4097	2.09
4	1988-89	12200	5822	2.09
5	1989-90	13392	6120	2.19
6	1990-91	13166	5293	2.49
7	1991-92	11166	6284	1.78
8	1992-93	12031	5970	2.01
9	1993-94	10669	6674	1.60
10	1994-95	12172	6635	1.83
Mean		11265	5609	2.03

Source: CADA, Neyyattinkara

It is clear that the palms in the command area are benefited by irrigation. On an average, palms in the command area had two times more yield than the average district productivity.

4.4.3 RBYI of Banana

RBYI of banana is depicted in the Table4.33. During the initial years the productivity in the ayacut was less than the district average. From 1989 to 1992 and 1994 -95 some improvement in yield was observed.

Table 4.33.RBYI of banana

Sl No	Year	Ayacut Yield (Kg/ha)	District Yield (kg/ha)	RBYI
1	1985-86	11200	11910	0.94
2	1986-87	11200	11014	0.93
3	1987-88	10500	11358	0.92
4	1988-89	11800	12769	0.92
5	1989-90	16700	13516	1.23
6	1990-91	14000	13909	1.01
7	1991-92	15200	14439	1.07
8	1992-93	14800	15483	0.95
9	1993-94	14800	13504	0.95
10	1994-95	15500	13504	1.15
Mean		13570	13141	1.01

Source: CADA,Neyyattinkara

It can be noted that on an average, productivity of banana in the ayacut area was not significantly higher than the district productivity. This may be due to the reason that banana (*Nendran*) is cultivated as an irrigated crop even in non-ayacut areas also. Low productivity for irrigated crops in Kerala was reported by

Government of Kerala (1996a). No satisfactory explanation was given for this phenomenon.

4.5 REVENUE FROM WATER CHARGES

There is no scientific water pricing policy in India. Water rates are fixed based on area cultivated, not based on volume in agriculture. The prevailing water rates are furnished in the Table 4.34.

Table 4.34 Water rates in the command area

Crop	Amount in Rs/ha/year
Single Crop	62
Double crop	99
3 crops	99
Others	62

The revenue from water charges in the command area was estimated by multiplying the area irrigated in each year with the corresponding water rates. The revenue so arrived is presented in the table 4.35

Table 4.35.Revenue from water charges paid/payable to the project

Year	Revenue from irrigation (Rs)
1976-77	613315
1977-78	613315
1979-80	613315
1980-81	613315
1981-82	613315
1982-83	613315
1983-84	613315
1985-86	640382
1986-87	640382
1987-88	640382
1988-89	640382
1989-90	640382
1990-91	640382
1991-92	640382
1992-93	640382
1993-94	640382
1994-95	782581
1995-96	782581
1996-97	782581
1997-98	782581
1998-99	782581
1999-00	782581
2000-01	782581
2001-02	782581
2002-03	892966
Total	17210258

An amount of Rs 172 lakh was realised as revenue from water charges from farmers in the command area from 1976-77 to 20032-03.

4.6 FINANCIAL SELF SUFFICIENCY

The Financial Self Sufficiency (FSS) was calculated by dividing the revenue from irrigation (water cess payable) by the total O & M expenditure. The details on operation and maintenance (O & M) expenditure is given in the Table 4.36

The FSS calculated by the above method for the project is 0.42.Only 42 per cent of the total operation and maintenance cost was recovered by the project.

$$FSS = \frac{17210258}{40634673} = 0.42$$

It revealed that the water charges could recover only 42 per cent of the O& M cost of the project.

When the subsidies given by the government was also considered as a component of the O&M cost FSS was still reduced to 0.08.

$$FSS = \frac{17210258}{211675946} = 0.08$$

It revealed that the project revenue from the water charges are inadequate to recover the O&M charges of the project. This is partly on account of the water rates, which were not revised from 1971 onwards and partly on account of low irrigation potential, realised against the targeted potential. As a huge amount is invested on such irrigation projects, it is expected that they recover at least the cost of maintaining the project on a no profit, no loss basis. Low FSS is not confined to NIP in the state. It has been reported for other irrigation projects in the state also (Suresh, 2000; Devi, 2002)

Table 4.36. Financial analysis of Neyyar Irrigation Project

Year	CI	O&M	COF	Subsidy	Water cess	CIF	CF	DOF	DIF	DCF
1970-71	231268	0	231268	0	0	0	-231268	206489.3	0	-206489
1971-72	331935	0	331935	0	0	0	-331935	264616.5	0	-264617
1972-73	393405	0	393405	0	0	0	-393405	280017.9	0	-280018
1973-74	509762	0	509762	0	0	0	-509762	323963	0	-323963
1974-75	1190014	0	1190014	0	0	0	-1190014	675245.9	0	-675246
1975-76	1406954	0	1406954	0	0	0	-1406954	712806.7	0	-712807
1976-77	880536	702245	1582781	0	613315	613315.1	-969465.88	715969.7	277432.6	-438537
1977-78	809009	822614	1631623	0	613315	613315.1	-1018307.9	658985.2	247707.7	-411277
1978-79	1045345	1041034	2086379	0	613315	613315.1	-1473063.9	752369.2	221167.6	-531202
1979-80	955724	195267	1150991	0	613315	613315.1	-537675.88	370588.3	197471.1	-173117
1980-81	1085911	2390948	3476859	0	613315	613315.1	-2863543.9	999513.9	176313.4	-823200
1981-82	792834	996560	1789394	0	613315	613315.1	-1176078.9	459292.9	157422.7	-301870
1982-83	1029479	205896	1235375	0	613315	613315.1	-622059.88	283116.1	140556	-142560
1983-84	1060893	212179	1273072	0	640382	640381.7	-632690.33	260495.8	131034.8	-129461
1984-85	967406	1660196	2627602	0	640382	640381.7	-1987220.3	480053.1	116995.3	-363058
1985-86	687087	143242	830329	0	640382	640381.7	-189947.33	135444.6	104460.1	-30984.5
1986-87	1884418	7769	1892187	1329258	640382	1969640	77452.667	275586.3	286866.9	11280.54
1987-88	15174	1396713	1411887	5498403	640382	6138785	4726897.7	183601.2	798285	614683.8
1988-89	407954	1594888	2002842	14652104	640382	15292486	13289644	232543.5	1775561	1543018
1989-90	0	1527946	1527946	9781382	640382	10421764	8893817.7	158397.2	1080391	921993.3
1990-91	0	3559081	3559081	14942792	640382	15583174	12024093	329427.2	1442373	1112945
1991-92	0	2394960	2394960	21394511	640382	22034893	19639933	197925.5	1821019	1623093
1992-93	0	2401532	2401532	23737069	782581	24519650	22118118	177204.1	1809255	1632051
1993-94	0	2453667	2453667	4278081	782581	5060662	2606995.3	161652.7	333407.1	171754.3
1994-95	11711	2397568	2409279	10899211	782581	11681792	9272513.3	141721.8	687161.7	545439.9
1995-96	0	2073730	2073730	6349753	782581	7132334	5058604.3	108914	374596	265682
1996-97	0	2472274	2472274	3879994	782581	4662575	2190301.3	115933.8	218644.8	102711.1
1998-99	0	3136171	3136171	5573568	782581	6356149	3219978.3	131309.2	266127.3	134818.1
1999-2000	0	3726134	3726134	10977564	782581	11760145	8034011.3	139295.1	439632.7	300337.7
2000-01	0	3040789	3040789	23271772	782581	24054353	21013564	101495.2	802884.4	701389.2
2001-02	550344	81270	631614	14475811	892966	15368777	14737163	18823.18	458016	439192.8
Total	16247163	40634673	56881836		17210257.8		131369695	10052798	14364781	4311983

BCR = 1.43 NPV= Rs 4311983 IRR=16.25%

4.7 FINANCIAL ANALYSIS

Financial analysis of the project was carried out by considering the subsidy given and revenue from water cess taken as project benefit. The details are given in the Table4.36. The BCR was estimated to be 1.48 which was more than one. The NPV was Rs 43.12 lakhs, which was a substantial amount. The FRR was 16 per cent, which was higher than the cost of capital (12%). This indicated that the project is financially sustainable at the level of the present subsidy support.

4.8 COST PRICING OF WATER

The concept of cost pricing off irrigation water is based on the logic that the water charges shall be based on the cost of developing and maintaining an irrigation system whether major or minor. Accordingly, the cost pricing of the present irrigation system was worked out as.

$$\text{Cost} = \frac{\text{Total cost(Capital investment + Operation and Maintenance)}}{\text{Total area benefited}}$$

$$= \frac{56881836}{231368} = 245.82 \text{ Rs per ha}$$

When the capital investment was annualised using a Capital Recovery Factor (CRF), by assuming the life of the dam as 80 years, the cost was

$$\text{Cost} = \frac{1949884.76 + 2104347.64}{9198.93} = \text{Rs } 440.73$$

Thus it can be seen that based on the financial cost of developing a water source and its supply, the cost of irrigation water shall range between Rs 245 to 440.75 per ha depending upon the present assumptions made. The present

rate of Rs 62 per ha for garden land and Rs 99 per ha for wetland is a highly subsidised rate and too low. Under pricing of canal irrigation is one of the major causes of over irrigation, wastage and misutilization. Water can no more be considered as a free gift of nature, and a higher opportunity cost reflecting its higher scarcity value is to be administered to bring about more efficiency in water use.

4.9 WILLINGNESS TO PAY

The consumers Willingness To Pay (WTP), is the maximum amount that an individual is willing to pay for a good/ service rather than going without it. Therefore, the WTP will include the amount that a consumer is actually paying for a good/ service plus the consumer surplus. The WTP for water at rates higher than the water rates realised reflected the value accorded to this resource by the farmers in the various commands for adequate and timely water supply. Since they are getting enough water they are not willing to pay more. The details of differing perceptions to the value of water are evident from the Table 4.37.

Table 4.37 Willingness to pay by the farmers for assured water supply

Stratum	Un willing to pay more	Up to Rs250/ha	Up to Rs 350/ha	Total
Head	20 (100)	0 (0)	0 (0)	20 (100)
Middle	17 (85)	2 (10)	1 (5)	20 (100)
Tail	6 (30)	2 (10)	12 (60)	20 (100)

Figures in parenthesis indicate per cent to total

It can be recalled that the head reach farmers had experienced no shortage of irrigation water due to the proximity to the reservoir. They were not willing to pay more than the current water rates. However, the middle and tail reach farmers

experienced water shortages, especially the tail reach farmers. As a result, 60 per cent of tail reach farmers were willing to pay as high as Rs 350/ ha for assured and timely water supply. These farmers who were experiencing more scarcity of water were assigning a higher value to assured and timely water availability. The middle reach farmers experienced occasional water shortages. Hence only 15 per cent of middle reach farmers were willing to pay even higher than the cost price for assured irrigation water.

4.10 SOIL AND WATER CONSERVATION MEASURES

Various soil conservation methods adopted by farmers included fodder cultivation on slopes and canal sides (Plate 4.1), terracing on slopes to reduce soil and water erosion, construction of field ditches to conserve water, construction of infiltration pits and stone pitching. The details of soil and water conservation measures adopted by the respondent farmers are presented in Table 4.38. Adoption of soil and water conservation measures was more among the beneficiary farmers as compared to the non beneficiary farmers. This was expected also. Only 40 per cent of beneficiary farmers adopted scientific soil and water conservation methods. Among the beneficiary farmers, adoption of conservation measures was more among the middle and tail reach farmers as compared to the head reach farmers.

Table. 4.38 Number of farmers adopting soil and water conservation methods

Stratum	Fodder cultivation	Terracing	Field ditches	Infiltration pits	Stone Pitching	Total
Head	1	0	3	0	0	4
Middle	0	2	9	0	0	11
Tail	0	1	8	0	0	9
Beneficiaries	1	3	20	0	0	24 (40)
Non beneficiaries	1	3	10	3	2	19 (31.67)

Figures in parenthesis indicate per cent to total

Plate 4.1 Soil conservation using folder grass

Among the various conservation measures adopted, construction of field ditches was the most prevalent method. Every year they used to construct canals for that (Plate 4.2). At the time of initial ploughing, they ploughed the land well and constructed the canal so that water available from the near by field canal would enter their field and it could be used according to their convenience. Only two non-beneficiary farmers did stone pitching. It included construction of stone pitched sidewalls for preventing soil erosion.

As far as the investment on soil conservation measures was concerned, the middle and tail reach farmers invested more money on scientific soil and water conservation as compared to the head reach farmers (Table 4.39). The head reach was less undulating as compared to the middle and tail reaches. This accounted for less investment on soil and water conservation measures by the head reach farmers. They were not constrained by canal water availability also.

Table 4.39 Amount invested by sample farmers on soil conservation by the respondents

(Rs /ha)

Stratum	Amount
Head	849
Middle	937
Tail	1323
Beneficiaries	1036
Non beneficiaries	995

4.11 DETAILS OF LAND RECLAMATION

The details on land reclamation are given in Table 4.40. The non-beneficiaries, in general, had more tendencies to reclaim the wetland when compared to beneficiary farmers. This accounted for the change in cropping pattern from paddy to crops like banana, tapioca, vegetables etc in the command area.

Plate 4.2 Field ditches for irrigating crops

Table 4.40 Details on land Reclamation by sample farmers by the respondents

Reach	No of farmers	Area reclaimed (ha)
Head	1	0.49
Middle	2	1.85
Tail	0	4.57
Beneficiaries	3	6.91
Non beneficiaries	7	10.35

Among the beneficiaries, the tail reach farmers reclaimed more wet area when compared to the head and middle reach farmers.

4.12 SHIFT IN CROPPING PATTERN IN THE COMMAND AREA

The details of the shift in the cropping pattern were collected from the records from CADA. It was available only up to the year 1994-95. Area under vegetables was not available. There were inconsistencies in area under banana. Hence, The same was estimated in consultation with the Department of Agriculture and BFAs. The details are depicted in Table 4.41

Table 4.41 Shift in cropping pattern in the command area from 1985-86 to 1994-95

	Area under crops (ha)					
Year	Banana*	Coconut	Paddy	Tapioca	Arecanut	Vegetables
1985-86	446	4574	5370	2729	156	175
1986-87	496	4725	5370	2648	151	180
1987-88	552	5070	5314	2250	122	186
1988-89	614	5308	5131	2183	133	191
1989-90	683	5446	5088	1986	118	196
1990-91	760	5377	5047	1788	100	201
1991-92	845	5210	5022	1716	89	207
1992-93	900	5445	5022	1706	88	213
1993-94	940	5470	5022	1553	75	219
1994-95	950	5470	5022	1537	74	225

Source : CADA, Neyattinkara

* includes Nendran and plantain

It can be seen that in general, there is a shift in cropping pattern from food crops like paddy and tapioca and cash crop like arecanut to more remunerative crops like coconut banana and vegetables. Paddy was not a popular crop in the command area in terms of the relative profitability and labour shortages. Banana and vegetables were two crops that gained considerable acreage from paddy cultivated area. They are highly remunerative crops so that they are widely cultivated even by the landless and agricultural labourers by taking on lease. Coconut is a safe crop with reasonable profitability and less risk. Irrigation bringing a shift in cropping pattern from seasonal to long duration crops, food crops to cash crops or low value crops to high value crops were reported by Udaya Kumar(1986), Mollinga (1998), Vaidyanathan (1994), and Sivasubramaniyan (2000).

4.13 ADDITIONAL EMPLOYEMENT GENERATION

The labour intensity of crops differed widely (Table 4.42).

Table 4.42 Per hectare labour requirement of crops

(Labour days/ha)

Sl No	Crop	Female	Male
1	Paddy	22	81
2	Coconut	142	31
3	Banana	340	55
4	Tapioca	85	35
5	Arecanut	72	18
6	Vegetables	290	38

Source: CADA Neyyattinkara

Hence a shift in cropping pattern is always associated with gain or loss in employment. These gain or losses were valued at respective wage rates during the reference period and depicted in Table 4.43.

Table 4.43 Wage earnings and loss on account of cropping pattern changes

Year	Paddy	Tapioca	Coconut	Banana	Vegetables	Arecanut	Total
1985-86	0	-225990	624989	477250	39860	-10710	905399
1986-87	-129752	-1239770	1596315	597800	53508	-69426	808675
1987-88	-465735	-230480	1217370	731910	49320	29106	1331491
1988-89	-118293	-724960	753618	869055	52600	-42390	789630
1989-90	-120335	-759330	-390885	1004465	54430	-52812	-264467
1990-91	-81100	-302040	-1032728	1209550	71220	-35244	-170342
1991-92	0	-45200	1567920	844800	76896	-3456	2440960
1992-93	0	-795600	195200	723200	90816	-52416	161200
1993-94	0	-93040	0	202850	101940	-4518	207232
Total	-915215	-4416410	4531799	6660880	590590	-241866	6209778

The details of estimation are depicted in Appendix II. The data was available from the year 1985-86 to 1993-94. Hence the exercise is confined to this period only. Moreover no shift in cropping pattern of significance was reported after this period. It can be seen that the loss in employment generation in paddy, tapioca and arecanut were offset by the gain in employment from crops like coconut banana and vegetables. A net gain of Rs 60 lakhs was generated on this account.

4.14 DETAILS OF SUBSIDIES

The subsidies were given by the CADA through the *Karshaka Samithies.* The details of the subsidies given over the years are presented in Table 4.44. Subsidies are admitted on the following components.

a) Survey design and planning
b) Construction of field canals
c) Construction of farm roads

d) Improvement of tanks
e) Land levelling and shaping
f) Field drain construction
g) Managerial subsidy
h) Training sponsored by Government of Kerala and Government of India
i) Ground water development
j) Reclamation of water logged area
k) Adaptive trial
l) Field demonstration
m) Warabahandhi
n) Subsidies to small and marginal farmers
o) Evaluation

Table 4.44 Amount of subsidies disbursed through Neyyar CADA

Year	Amount(Rs)
1986-87	1329258
1987-88	5498403
1988-89	14652104
1989-90	9781382
1990-91	14942792
1991-92	21394511
1992-93	23737069
1993-94	4278081
1994-95	10899211
1995-96	6349753
1996-97	3879994
1997-98	5573568
1998-99	10977564
1999-00	23271772
2000-01	14475811
2001-02	2927255
2002-03	3687092
2003-04	7702615

Source: CADA, Neyyattinkara

Table 4.44 Economic analysis of Neyyar Irrigation Project

Year	CIF	Incremental Income	Employment generation	Subsidy	ECOF	ECIF	ECF	DOF	DIF	EDCF
1970-71	0	0	0	0	231268	0	-231268	206489.3	0	-206489
1971-72	0	0	0	0	331935	0	-331935	264616.5	0	-264617
1972-73	0	0	0	0	393405	0	-393405	280017.9	0	-280018
1973-74	0	0	0	0	509762	0	-509762	323963	0	-323963
1974-75	0	0	0	0	1190014	0	-1190014	675245.9	0	-675246
1975-76	0	0	0	0	1406954	0	-1406954	712806.7	0	-712807
1976-77	613315	0	0	0	1582781	613315.12	-969465.88	715969.7	277432.6133	-438537
1977-78	613315	0	0	0	1631623	613315.12	-1018307.88	658985.2	247707.6904	-411277
1978-79	613315	0	0	0	2086379	613315.12	-1473063.88	752369.2	221167.5807	-531202
1979-80	613315	0	0	0	1150991	613315.12	-537675.88	370588.3	197471.0542	-173117
1980-81	613315	0	0	0	3476859	613315.12	-2863543.88	999513.9	176313.4413	-823200
1981-82	613315	0	0	0	1789394	613315.12	-1176078.88	459292.9	157422.7154	-301870
1982-83	613315	0	0	0	1235375	613315.12	-622059.88	283116.1	140555.9959	-142560
1983-84	640382	0	0	0	1273072	640381.67	-632690.333	260495.8	131034.7766	-129461
1984-85	640382	0	0	0	2627602	640381.67	-1987220.33	480053.1	116995.3363	-363058
1985-86	640382	0	0	0	830329	640381.67	-189947.333	135444.6	104460.1217	-30984.5
1986-87	640382	70500000	905399	1329258	3221445	72045781	68824335.67	469185.2	10493060.24	10023875
1987-88	640382	64100000	808675	5498403	6910290	65549057	58638766.67	898611.3	8523972.462	7625361
1988-89	640382	62500000	1331491	14652104	16654946	64471873	47816926.67	1933752	7485621.335	5551869
1989-90	640382	86900000	789630	9781382	11309328	88330012	77020683.67	1172401	9156886.569	7984485
1990-91	640382	80200000	-264467	14942792	18501873	80575915	62074041.67	1712526	7458075.372	5745549
1991-92	640382	125600000	-170342	21394511	23789471	126070040	102280568.7	1966022	10418744.57	8452723
1992-93	782581	125100000	2440960	23737069	26138601	128323541	102184940.3	1928714	9468731.788	7540018
1993-94	782581	153000000	161200	4278081	6731748	153943781	147212033.3	443501.7	10142140.11	9698638
1994-95	782581	140500000	207232	10899211	13308490	141489813	128181323.3	782849.4	8322898.664	7540049
1995-96	782581	166500000	0	6349753	8423483	167282581	158859098.3	442408.1	8785816.574	8343408
1996-97	782581	166500000	0	3879994	6352268	167282581	160930313.3	297880.6	7844479.084	7546598
1998-99	782581	166500000	0	5573568	8709739	167282581	158572842.3	364670.4	7003999.182	6639329
1999-2000	782581	166500000	0	10977564	14703698	167282581	152578883.3	549672.4	6253570.698	5703898
2000-01	782581	166500000	0	23271772	26312561	167282581	140970020.3	878258.7	5583545.266	4705287
2001-02	892966	166500000	0	14475811	15107425	167392966	152285541.3	450227.2	4988597.936	4538371
Total	17210258							21869648	123700701.2	101831052.9

BCR=5.66 NPV= Rs 101831052.95 IRR=35.47%

4.15 ECONOMIC ANALYSIS

While conducting the economic analysis, the subsidy disbursed was considered as cost on the economy. Incremental income from additional crop production, and additional employment generated were also considered besides water cess in arriving at the total cash inflow (Table 4.45). It was found that when the direct and indirect benefits were considered in the analysis after removing distortions on account of the subsidy components, BCR increased to 5.66 per rupee invested. The NPV was estimated to Rs 1018.31 lakhs. The rate of economic returns was 35.47 per cent, which is quite higher than the cost of capital reckoned at 12 percent. Thus, it can be seen that the project was making a positive impact to the society.

The economic price of irrigation water was worked out by treating subsidies given under various project heads as a social cost as shown below:

$$= \frac{1949884.76+7621808.06}{9198.93} = \text{Rs}1040.52/\text{ha}$$

The analysis clearly illustrates that at present, the water rates bear no relation ship with the real cost of supplying water. It is not financially or economically sound and efficient.

4.16 DETAILS OF TRAININGS

Various training programmes were organized by CADA for skill development of the farmers in the command area. The trainings were sponsored either by Government of Kerala or Government of India. The details of various training programmes conducted were as follows

The objective of farmers trainings were to impart training in the field of water management, scheduling, solutions to different problem confronted in the field, crop production problem etc. Trainees were selected from the farmers *Karshaka Samithies*.

Training tours were also organized to expose selected members of the *Karshaka Samithies* to scientific water management, water scheduling, *warabhandhi*, efficient use of water for crop production etc, to the 40 selected members from the *Karshaka samithi* . Six days outside the state tour was organized in this connection.

Field days were also observed to for 75 to 100 farmers where farm canals were taken and where *warabhandhi* was implemented. Trainers were agricultural and engineering experts. Harvest festival and other demonstrations like application of fertilizers, spraying, preparation of pesticides and fungicides etc were combined along with this training

One day training was also given to agricultural labourers to enhance their skills like planting of seedling, spraying fertilizer application, different operations, harvesting and post harvest techniques etc to 80 selected farmers from *Karshaka samithi.* Year wise expenditure on the various trainings organized by Neyyar CADA is furnished in Table 4.46.

In addition, project level seminars were organized to identify problems and solutions of water management, and *Warabandhi* giving exposure to crop production, and cropping pattern in the project area.

Table 4.46 Amount spent on conducting training in Neyyar CADA

Year	Training sponsored by GOI	Training sponsored by GOK
1986-87	0	0
1987-88	0	0
1988-89	0	0
1989-90	0	0
1990-91	29475	0
1991-92	35391	0
1992-93	0	75142
1993-94	0	91061
1994-95	0	85511
1995-96	0	77055
1996-97	0	61013
1997-98	0	145783
1998-99	0	208047
1999-00	0	240692
2000-01	0	41000
2001-02	0	2750
2002-03	0	52200
2003-2004	0	0
	64866	1080254

Source CADA, Neyyattinkara

It can be seen that Rs10.80 lakhs and 0.65lakhs respectively were spent by the Government of Kerala and the Government of India in organising different types of trainings as described in Table4.45. There was no allotment for training during the year 2003-04 because the Central Government assistance for CADA ceased during the year and the Government of Kerala has introduced revamping and consolidation programme for augmenting water use efficiency of the old generation projects in the state. NIP is also selected for revamping programme and the detailed base line study are being carried out.

4.17 PARTICIPATION IN BFA MEETINGS

Various BFAs conducted meetings once in a month or once in two months. The type of participation and the level of participation varied among different farmer groups. Out of the 317 registered BFAs only 80 were live.

4.17.1 Type of Participation

The details of farmer participation in BFA meetings are presented in Table 4.47.

Table 4.47 Type of participation of farmers

No	Particulars	Head	Middle	Tail
1	Interactive participation	4 (20)	7 (35)	4 (20)
2	Participation by agreeing to decisions	6 (30)	5 (25)	10 (50)
3	Participation for material inputs and subsidies	3 (15)	3 (15)	4 (20)
4	Passive participation	7 (35)	5 (25)	2 (10)

Figures in parenthesis indicate per cent to total

It may be noted that the majority of head reach farmers were either participating passively (35%) or participating by agreeing to decisions (30%) in the BFA meetings. This is understandable as the head reach farmers had less stake in BFA decisions. However, 35 per cent middle reach farmers had interactive participation in BFA meetings while one fourth were either participating passively or participating by agreeing to decisions. Surprisingly, 50 per cent of the tail reach farmers participated in BFA meetings by agreeing to decisions even though they had higher stakes in BFA meetings. Only 20 per cent of the tail reach farmers had interactive participation in BFA meetings. It indicated that the institution of

participatory irrigation management was not scored in the command area. Such low beneficiary participation was reported by Joseph (2001) in the Malampuzha command area in Kerala.

4.17.2 Frequency of Participation

The details of frequency of attending BFA meetings by the head middle and tail reach farmers are given in Table 4.48

Table 4.48. Level of participation in BFA meetings

Stratum	All	Regularly with few exceptions	Rarely	Total
Head	10 (50)	10 (50)	0 (0)	20 (100)
Middle	11 (55)	7 (35)	2 (10)	20 (100)
Tail	4 (20)	5 (25)	11 (55)	20 (100)

Figures in parenthesis indicate per cent to total

It can be seen that 50 per cent of head reach farmers attended all the BFA meetings while 55 per cent of middle reach farmers attended all the BFA meetings. Only 20 per cent of tail reach farmers attended all the BFA meetings. It is disturbing to note that while majority of the head and middle reach farmers attended BFA meetings regularly, only 45 per cent of the tail reach farmers attended BFA meetings regularly. In fact, 55 per cent of tails reach farmers rarely attended BFA meetings.

There was instances were the farmers from the list of beneficiaries were not aware of what CADA is. Members of BFA complained that the president or secretary was enrolling bogus family members or relatives as BFA member so that all the subsidies will be available to a vested group. This resulted in actual farmers not getting the benefits. The farmers had a wide spread opinion that

CADA is not beneficial for the farmers. So there is no point in wasting time by attending BFA meetings. This was the main reason for the participation in BFA meetings.

4.18. OPERATIONAL PROBLEMS IN ON FARM IRRIGATION

The operational problems faced by farmers in on farm irrigation were identified and presented in Table 4.49

Table 4.49. Score for operational problems faced by farmers in the command area

Strata	Water Scarcity in summer	Improper maintenances and lack of timely desiltation	Unscientific construction of canals	Wastage of water and poor canal lining
Head	24	10	7	3
Middle	31	17	11	6
Tail	80	34	6	15
Beneficiaries	135	61	24	24

The main problem faced by farmers irrespective of the strata was non-availability of water in summer, when the need of farmers was high. Farmers complained that the Irrigation Department closing the canals during February and March in order to get the financial accounts settled, and the farmers were not getting enough water during this period. Water is not released in the subsequent months also because water level in the dam will be low during the period.

Improper maintenance of the sluice and lack of timely desiltation (Plate 4.3) was sited as the second, major problem. The sluices are not properly working. Sluice leakage was common mainly because of the damage caused by anti social elements. The closure and opening of sluices were not in accordance with the

Plate 4.3 Improper maintenance of canal

farmer's need. The fields nearer to the canal receive more water at the expense of those plots, which are located away. The head reach farmers used to tap water illegally (Plate 4.4) so that they are always getting enough water.

Another problem faced by the farmer was on account of unscientific construction of canal. This problem was more acute for the tail end farmers. The problem of water scarcity was less for the head reach farmers because they used to get water always in the canals due to the leakage in the shutter even if water is not released from the dam (Plate 4.5).

The canals are not constructed in accordance to the slope of the area. In Thembamuttom and nearby areas the canal is very deep and farmers feel difficulty in getting water due to the difference in the height of canal and plots. This problem was more acute in the middle reaches. The farmers expressed the view that they should also be involved in planning the field canals

The canals in the tail end were not lined because water was not available throughout the year. This led to wastage of water due to poor canal lining whenever water was released. Instances of the encroachment of canals and construction of roads have taken place with impunity.

4.19 PROBLEMS IN ROTATIONAL WATER DISTRIBUTION (WARABANDHI)

Warabhandhi is defined as a system of equitable water distribution by turns according to pre-determined schedules, specifying the date, time and duration of supply to each irrigator in proportion to his area in an outlet command. It is a rotational water distribution system to ensure equity. The details of rotational water distribution are furnished in Table 4.50.

Plate 4.4 Illegal tapping by head reach farmers

Plate 4.5 Lined canal in head reach

Table 4.50 Farmers enjoying *Warabandhi*

Strata	No of Farmers
Head	20 (100)
Middle	17 (85)
Tail	0 (0)

All the head reach farmers received water according to their requirement while only 85 per cent of middle reach farmers received water according to their requirement. Actually, the rotational distribution of water was not correctly followed in the command area. None of the tail reach farmers received water according to their requirement. In fact during the survey, farmers were encountered who were not aware of what *Warabandhi* is. The main problem observed was that the Irrigation Department and CADA were not having proper coordination. As a result, release of water was not in accordance with farmer's need.

It can be observed that water was not available in sufficient quantities when the maximum was needed during the dry months. If water supply is not in accordance with the crop requirements they can have negative impact on crop production than a positive impact. This underlines the need for scientific scheduling of irrigation according to the crop requirements.

The schedule of water release as envisaged by NIP is depicted in the Table 4.51.

Table 4.51 Schedule for distribution of water at NIP

Opening	Closing
1st May-31 st August	June
1 st July-31 st August	1 st September-15 September
16thSeptember-30 thSeptember	16th January-15th February
15thFebruary-31 st March	1st April-30 th April

However, the actual water release was not according to this schedule.

The fore going analyses gave sufficient insights into the following impact indicators.

- The beneficiary farmers had devoted relatively more area under water demanding cash crops like banana and vegetables.

- The beneficiary farmers had a relatively higher cropping intensity than the non beneficiary farmers.

- The crop productivity of the beneficiary farmers were higher in the case of irrigated crops like coconut, banana, and vegetables. In the case of rainfed crops like tapioca the crop productivity was higher for the non beneficiary farmers than the beneficiary farmers.

- The dependence and income from agriculture was higher for the beneficiary farmers as compared to the non beneficiary farmers. The non beneficiary farmers had less dependence on agriculture and there fore a higher non farm income. Consequently the total household income was higher for the non beneficiary farmers as compared to beneficiary farmers.

- The beneficiary farmers had undergone diverse trainings in the areas of water management, crop production and other areas of skill development like scientific soil and water management.

- The adoption of scientific soil and water management measures were higher among the beneficiary farmers as compared to the non beneficiary farmers, though the rate of adoption is 40 per cent only

- The current water rates were not reflecting either the financial or economic cost of developing and maintaining the irrigation project. No rationale was noticed in fixing the current water charges.

Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

Water is the most precious natural resource providing life-supporting system for plants, animals as well as human beings. That is why most of the progressive civilizations in the past existed along the watercourses or near the water bodies. The twentieth century witnessed tremendous growth in the use of water resulting in a mismatch between per capita water availability and its use. Water was considered as a scare commodity and its efficient use is assuming more importance, especially in view of huge capital investments made on developing and maintaining irrigation projects. It is against this background that the study entitled "Impact of Command Area Development Authority: An Economic Analysis of Neyyar Irrigation Project" was undertaken with the specific objectives of evaluating the socio-economic impact of Neyyar Irrigation Project in the command area and to identify the operational problems.

The study was carried out during the year 2003-04. The study was based on primary as well as secondary data. The secondary data required for the study were collected from various government agencies such as CADA, Neyyar; Irrigation Department, Government of Kerala; Department of Economics and Statistics and the State Planning Board. The primary data were gathered through personal interview, using a structured and pre-tested schedule of enquiry. A stratified random sampling method was employed to collect information from farmers. Two BFAs each was selected from head, middle and tail reaches. Ten beneficiary farmers were selected randomly from each BFAs so that 60 beneficiary farmers were selected. Sixty non-beneficiary farmers were also selected at random from the region of BFAs and near by area. Tabular analysis was conducted to study the socio economic characteristic of the respondents and to estimate the operational expenses, returns and gross margin. Various irrigation indicators such as Actual Area utilization Index, Rain fed Based Yield Index and the Financial Self Sufficiency ratios were worked out. The financial and economic

analysis of cost and benefit generated by the project in the command area were conducted using Benefit Cost Ratio (BCR) Net Present Value (NPV) and Internal Rate of Returns (IRR). The level of participation of the beneficiary farmers in the activities of BFAs was also assessed. Finally the operational problems in on farm irrigation were identified and ranked based on the relative importance as perceived by farmers.

The study revealed that while the beneficiary farmers devoted more cropped area under more water demanding crops, the non-beneficiaries gave less thrust on water demanding crops. The cropping intensity (115.68%) and gross area irrigated (81.3 %) was more for beneficiaries compared to non-beneficiaries.

The major crop enterprises studied were banana, coconut, tapioca, rice and vegetables. In banana, an increased yield of 20951 kg per hectare was obtained for beneficiaries when compared to non beneficiaries (18837.80 kg). In coconut, the higher yield of 9589 nuts per hectare per year was obtained when compared to non-beneficiaries (9146 nuts per hectare per year). In vegetables also, there was an increase in yield for the beneficiaries. In the case of rainfed crops like tapioca, yield was more for non-beneficiary farmers.

Income from agriculture was higher for beneficiary farmers (73%) as compared to the non-beneficiary farmers (63%). The non-beneficiary farmers had lesser dependence on agriculture, and therefore higher non-farm income. Consequently, the total household income was higher for non-beneficiaries compared to the beneficiary farmers.

Various irrigation indicators were worked out. Actual Utilization Index shows that the cumulative area actually brought under irrigation had increased from 54 per cent in 1985 to 75 percent in 2003. Rain fed Based Yield Index of the crops in the command area indicated a positive contribution from irrigation. The Financial Self Sufficiency ratio showed that the revenue from water cess was

recovering only 8 per cent of the operation and maintenance cost of the project in the real sense. The financial analysis was carried out which indicated that the project was financially attractive with the huge level of subsidy components. The BCR was estimated to 1.43, the NPV was Rs 43.12 lakhs, and the financial rate of return was 16 per cent, which was higher than the cost of capital (12%). The economic analysis of the project by correcting the distortions on account of subsidies revealed that the project was economically attractive to the society even when the subsidies were classified as a social cost of running the project with a BCR of 5.66, a NPV of Rs 1018.31 lakhs and an economic rate of returns of 35.47 per cent. It highlighted the fact that the return on irrigation investment was high.

The water rate is not reflecting the financial or physical cost of supplying irrigation water, and it is abysmally low. The willingness to pay for irrigation water was higher than the current water rates and the financial costing. The willingness to pay for irrigation water differed among the farmers from between three reaches. The willingness to pay was more for tail and middle reach farmers. Scientific soil and water conservation methods were adopted more by the beneficiary farmers than the non-beneficiary farmers. Several trainings had been conducted by CADA for the farmers on water management, crop production and other areas of skill development like scientific soil and water management. The level of participation of farmers was poor in the meetings of beneficiary farmers association. Farmers involvement in the agriculture activity conducted by CADA was also not satisfactory.

The operational problems in on- farm irrigation were water scarcity in summer, improper maintenance of canals, lack of timely desiltation, unscientific channel construction and wastage of water and poor canal lining. All the problems were more acute to the tail reach farmers. There was no supply of water according to the crop requirement, and the system of rotational water supply (*Warabandhi*) was not practised.

Based on the findings of the study the following policy implications are suggested:

1) Most of the canal irrigation systems in South East Asia are run-off-the river type and are designed to harvest excess run off during the rainy season with a view to divert the same into the canal net work during the dry months. However, a central problem related to water resource development programme in such systems is that the time and area of water availability does not match with its requirement. The problem is particularly relevant to Kerala in view of the peculiar hydrological and climatological characteristics. Hence, any scientific irrigation policy shall start by developing a scientific irrigation scheduling based on crop requirement. The enforcement of *Warabandhi* shall form a definite component of this policy.

2) An overriding consideration in irrigation investments has been bringing more area under irrigation with out any regard for efficient use of water at a cost that would ensure proper use. There is no scientific water pricing mechanism in the state at present. The water rates are not revised for decades, and kept abysmally low. A rational water pricing policy that would reflect the cost of supplying water is urgently required. If needed a differential pricing policy based on equity considerations such as size of holding, crops cultivated, and income level can be thought of.

3) The loss of water during transit was very high in the command area. Proper desiltation and maintenance of canals were not undertaken regularly. Shutters of the dam were not maintained properly, resulting in loss of precious water due to leakage. Hence, the annual maintenance of the canals must receive more priority.

4) Inequities in water sharing were noticed in the command area. The water distribution shall ensure that the farmers in the head, middle and tail reaches shall have equal access to irrigation water.Use of water saving technologies like drip and sprinkler irrigation was low. Most farmers irrigated by flooding. The increased use of water economizing methods will cut down the aggregate demand for water. Thus, the available water can be distributed more equitably.

5) Farmer participation in irrigation management was found to be low in the real sense. BFAs are the backbone of participatory irrigation management (PIM). BFAs will not be functionally efficient by mere executive orders. The BFAs shall be reorganized to make them functionally more vibrant.

6) There is a widespread notion that irrigation by itself would do miracles for the crop. Effective utilization of irrigation investment requires appropriate know-how and experience to the end users. Introduction of modern water management shall go hand in hand with the introduction of modern agricultural production technology. At present irrigated agriculture is banking heavily on traditional crop management practices. The agricultural activities of CADA shall be strengthened to meet this objective and finally, better co-ordination is required between the Command Area Development Authority and the Irrigation Department.

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Appendices

APPENDIX 1

SCHEDULE FOR THE SURVEY OF IMPACT OF COMMAND AREA DEVELOPMENT AUTHORITY:ECONOMIC ANALYSIS OF NEYYAR IRRIGATION PROJECT

1.Name and Address of the farmer :

2.Stratum :Upper reach/Middle Reach/Tail Reach
3.Type of Farmer :Beneficiary/Nonbeneficiary
4.Name of the BFA :
5.Date of interview :

6.Family composition

Sl. No.	Name	Sex	Age	Educational Qualification	Involved in farm operations Y/N	If employed else where give details

7) Caste :

8)Size of land holding :
Details of land holding in (acres)

Particulars	Owned	Leased in	Leased out	Area available for cultivation	Current fallow	Area available for cultivation more than once
a) Wet land b) Garden land						

9.Cropping pattern

Crops	Irrigated	Non-irrigated	Source of irrigation
Seasonal			
Annual			
Perennial			

Crops	Area(cents)	No of Plants	Area(cents)	No of plants
Seasonal				
1				
2				
3				
4				
5				
6				
Annual				
1				
2				
3				
4				
5				
6				
Perennial				
1				
2				
3				
4				
5				
6				

10.Details of Livestock

Type of animal	Yield

11.Indicate the nature of cropping pattern changes and its extend during the last 15 years along the reasons:

12.Year from which water is available in the field channel:
13.Imapact on water availability:

14. Pattern of farm investment

Item	Year of Purchase/ installation/in vestment	Purchase price/ unit	Maintenance cost (fuel, repair, hire charges)
a) Building			
i) Permanent			
ii) Temporary			
b) Equipment, machinery			
c) Tools			
d) Farm development			
i) Land reclamation			
ii) Irrigation system			
e) Digging of open/tube well /ponds etc.			
f) Motor pump set,			
g) Pump House			
h) Hose			
i) Sprinkler/ drip			
j) Others(specify)			

15) Farm and non farm income :

Sl. No.	Family member	Service	Business	Labour	Crops	Livestock	Others

16) Soil and water conservation measures undertaken in the farm during the last 15 years:

Sl No	Type of work	Approximate cost(Rs)	Loan Component (Rs)	Subsidy component(Rs)

17) Details of water table status:

Normal period
Summer period
Changes during water release (recharge)

18) Cost of cultivation of major enterprises:

a) Crop : Variety/Cultivar used: Sowing time:

Operations	Human labour days					Machinery		Materiel costs		
	Permanent		Casual		Wage rate	Hrs	Operating charges	Item	Qty	Price/ unit
	M	F	M	F				Seed		
Land preparation										
Soil amendment application								Org.manure 1 2 3		
O.M. application								Fertilizers 1 2 3 4		
Sowing/ Planting								Herbicides		
Fertilizer application								P.P. Chemicals		
i) Basal										
ii) Top dressing 1) 2) 3) 4) 5)								Soil amendments		
								Fuel/ electricity		
Irrigation								Water charges		
1.								Miscellaneous		
2.										
3.										
4.										
5.										
Intercultural Operations										
1.										
2.										
3.										
4.										

Harvesting

Operations	Human labour days					Machinery		Materiel costs		
	Permanent		Casual		Wage rate	Hrs	Operating charges	Item	Qty	Price/ unit
	M	F	M	F						

Yield details

Yield	Price prevailed/prevailing

b) Crop : Variety/Cultivar used: Sowing time:

Operations	Human labour days					Machinery		Materiel costs		
	Permanent		Casual		Wage rate	Hrs	Operating charges	Item	Qty	Price/ unit
	M	F	M	F				Seed		
Land preparation										
Soil amendment application								Org.manure 1 2 3		
O.M. application								Fertilizers 1 2 3 4		
Sowing/ Planting								Herbicides		
Fertilizer application								P.P. Chemicals		
i) Basal										
ii) Top dressing 1) 2) 3) 4) 5)								Soil amendments		
								Fuel/ electricity		

Irrigation								Water charges		
1.								Miscellaneous		
2.										
3.										
4.										
5.										
Intercultural Operations										
1.										
2.										
3.										
4.										

Harvesting

Operations	Human labour days					Machinery		Materiel costs		
	Permanent		Casual		Wage rate	Hrs	Operating charges	Item	Qty	Price/ unit
	M	F	M	F						

Yield details

Yield	Price prevailed/prevailing

c) Crop : Variety/Cultivar used: Sowing time:

Operations	Human labour days					Machinery		Materiel costs		
	Permanent		Casual		Wage rate	Hrs	Operating charges	Item	Qty	Price/ unit
	M	F	M	F				Seed		
Land preparation										
Soil amendment application								Org.manure 1 2 3		

O.M. application								Fertilizers 1 2 3 4		
Sowing/ Planting								Herbicides		
Fertilizer application								P.P. Chemicals		
i) Basal										
ii) Top dressing 1) 2) 3) 4) 5)								Soil amendments Fuel/ electricity		
Irrigation								Water charges		
1.								Miscellaneous		
2.										
3.										
4.										
5.										
Intercultural Operations										
1.										
2.										
3.										
4.										

Harvesting

Operations	Human labour days					Machinery		Materiel costs		
	Permanent		Casual		Wage rate	Hrs	Operating charges	Item	Qty	Price/ unit
	M	F	M	F						

Yield details

Yield	Price prevailed/prevailing

19.Level of participation

Sl. No	Particulars	Details
1.	Membership of BFA	Y/N
2.	Year of BFA formation	
3.	Mode of organization and initiatives	
4.	Whether holding official position of BFA committee	Y/N
5.	If yes give details	
6.	Frequency of BFA meetings	
7.	No of meetings attended	
8.	Type of participation	Passive participation / participating by agreeing to decisions / Participation for material inputs and subsidies / Interactive participation

20.Farmer's perception towards water availability

1.	Are you receiving water by rotation (Warabandhi)	Y/N
2	Do you get prior information about water release	Y/N
	a. If Yes, how do you get the above information	
	b. Do you receive adequate supply	Y/N
	c. Timely release	Y/N
3.	If you are provided adequate water in time are you willing to pay more	Y/N
	If yes, indicate limits of willingness to pay for timely and assured water availability	

21.Operational problems in on-farm irrigation

22.What are the benefits you receive from CADA

APPENDIX-II

Average wage rate of male and female labourers in Thiruvananthapuram

Year	Wage rate(Male)	Wage rate(Female)
1985-86	25	19
1986-87	28	21
1987-88	31	23
1988-89	33	25
1989-90	34	27
1990-91	37	30
1991-92	40	32
1992-93	48	32
1993-94	54	35
1994-95	63	42
1995-96	77	51
1996-97	92	61
1997-98	104	69
1998-99	112	71
1999-00	119	79
2000-01	123	82
2001-02	127	88

Average labour requirement of crops

Sl no	Crops	Male	Female
1	Paddy	22	81
2	Coconut	142	31
3	Banana	340	55
4	Tapioca	85	35
5	Arecanut	72	18
6	Vegetables	290	38

Change in area of crops in the command area(ha)

Year	Paddy	Coconut	Banana	Tapioca	Arecanut	Vegetables
1985-86	0	151	50	-81	-5	5
1986-87	-56	345	56	-398	-29	6
1987-88	-183	238	62	-67	11	5
1988-89	-43	138	69	-197	-12	5
1989-90	-41	-69	77	-198	-18	5
1990-91	25	-167	85	-72	-11	6
1991-92	0	235	55	-10	-1	6
1992-93	0	25	40	-153	-13	6
1993-94	0	0	10	-16	-1	6
1994-95	0	0	0	0	0	0

Male and female labour charges on various crops

Year	Paddy		Coconut		Banana		Tapioca		Arecanut		Vegetables	
	ML	FL	ML	FL	ML	FL	ML	FL	ML	FL	ML	FL
1985-86	550	1539	3550	589	8500	1045	2125	665	1800	342	7250	722
1986-87	616	1701	3976	651	9520	1155	2380	735	2016	378	8120	798
1987-88	682	1863	4402	713	10540	1265	2635	805	2232	414	8990	874
1988-89	726	2025	4686	775	11220	1375	2805	875	2376	450	9570	950
1989-90	748	2187	4828	837	11560	1485	2890	945	2448	486	9860	1026
1990-91	814	2430	5254	930	12580	1650	3145	1050	2664	540	10730	1140
1991-92	880	2592	5680	992	13600	1760	3400	1120	2880	576	11600	1216
1992-93	1056	2592	6816	992	16320	1760	4080	1120	3456	576	13920	1216
1993-94	1188	2835	7668	1085	18360	1925	4590	1225	3888	630	15660	1330
1994-95	1386	3402	8946	1302	21420	2310	5355	1470	4536	756	18270	1596
1995-96	1694	4131	10934	1581	26180	2805	6545	1785	5544	918	22330	1938
1996-97	2024	4941	13064	1891	31280	3355	7820	2135	6624	1098	26680	2318
1997-98	2288	5589	14768	2139	35360	3795	8840	2415	7488	1242	30160	2622
1998-99	2464	5751	15904	2201	38080	3905	9520	2485	8064	1278	32480	2698
1999-00	2618	6399	16898	2449	40460	4345	10115	2765	8568	1422	34510	3002
2000-01	2706	6642	17466	2542	41820	4510	10455	2870	8856	1476	35670	3116
2001-02	2794	7128	18034	2728	43180	4840	10795	3080	9144	1584	36830	3344

Total labour charges per hectare for various crops

Year	Paddy	Coconut	Banana	Tapioca	Arecanut	Vegetables
1985-86	2089	4139	9545	2790	2142	7972
1986-87	2317	4627	11875	3115	2394	8918
1987-88	2545	5115	11805	3440	2646	9864
1988-89	2751	5461	12595	3880	2826	10520
1989-90	2935	5665	18045	3835	2934	10886
1990-91	3244	6184	14230	4195	3204	11870
1991-92	3472	6672	15360	4520	3456	12816
1992-93	3648	7808	18080	5200	4032	15136
1993-94	4023	8753	20285	5815	4518	16990
1994-95	4788	10248	23730	6825	5292	19866
1995-96	5825	12515	28985	8330	6462	24268
1996-97	6965	14955	34635	9955	7722	28998
1997-98	7877	16907	39155	11255	8730	32782
1998-99	8215	18105	41985	12005	9342	35178
1999-00	9017	19347	44805	12880	9990	37512
2000-01	9348	20008	48330	13325	10332	38786
2001-02	9922	20762	48020	13875	10728	40174

IMPACT OF COMMAND AREA DEVELOPMENT AUTHORITY (CADA) : AN ECONOMIC ANALYSIS OF NEYYAR IRRIGATION PROJECT

ASWATHY VIJAYAN

ABSTRACT OF THE THESIS

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Faculty of Agriculture
Kerala Agricultural University, Thrissur

Department of Agricultural Economics

COLLEGE OF HORTICULTURE
VELLANIKKARA, THRISSUR - 680 656
KERALA, INDIA

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ABSTRACT

Water is the most precious natural resource providing life-supporting system for plants, animals as well as human beings. The twentieth century witnessed a tremendous growth in the use of water resulting in a mismatch between per capita water availability and its use. It is against this background that the study entitled "Impact of Command Area Development Authority: An Economic Analysis of Neyyar Irrigation Project" was undertaken with the specific objectives of evaluating the socio-economic impact of Neyyar Irrigation Project in the command area and to identify the operational problems.

The study was carried out during the year 2003-04. The study was based on primary as well as secondary data. A stratified random sampling method was employed to collect information from 60 beneficiary farmers from the head, middle and tail reaches, and 60 non-beneficiary farmers.

The study revealed that while the beneficiary farmers devoted more cropped area under more water demanding crops, the non-beneficiaries gave less thrust on water demanding crops. The cropping intensity (115.68%) and gross area irrigated (81.35%) was more for beneficiaries when compared to non-beneficiaries. The crop productivity and gross margin of major crop enterprises like banana, coconut, and vegetables were higher for the beneficiary farmers than the non-beneficiaries. The increase in yield was 11.22 per cent for banana (*Nendran*), and 4.84 per cent for coconut. In vegetables also, the crop yield was higher for the beneficiaries. In the case of rain fed crops like tapioca, the crop yield was more for non-beneficiary farmers. The actual utilization index showed that the cumulative area actually brought under irrigation has increased from 53 per cent in 1985 to 75 percent in 2003. The Financial Self Sufficiency ratio showed that the revenue from water cess was recovering only 8 per cent of the operation and maintenance cost of the project. The financial analysis was carried out and which indicated the project was financially attractive with a benefit-cost

ratio was estimated to 1:48, the NPV was Rs 43.12 lakhs, and the financial rate of return of 16 per cent. The economic analysis of the project by correcting the distortions on account of subsidies revealed that the project was economically attractive to the society with a benefit cost ratio of 5.66, a net present value of Rs 1018.31 lakh. The economic rate of returns on the irrigation investment was 35.47 per cent. The operational problems in on- farm irrigation were water scarcity in summer, improper maintenance of canals, lack of timely desiltation, unscientific channel construction and wastage of water and poor canal lining. There was no supply of water according to the crop requirement, and the system of rotational water supply (*Warabandhi*) was not practised.