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IMPACT EVALUATION STUDY OF NWDPRA SCHEME IMPLEMENTED DURING NINTH FIVE YEAR PLAN

E.K. Thomas
K. Jessy Thomas
K. Satheesh Babu
C. George Thomas
Latha Bastine
Elsamma Job

DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF HORTICULTURE
KERALA AGRICULTURAL UNIVERSITY
VELLANIKKARA – TRICHUR – 680 656

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Impact Evaluation Study of NWDPRA Scheme implemented during Ninth Five Year Plan in Kerala

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Fax No. 91 487 370019
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E-Mail
Phone Off. 91 0487 2371302

KERALA AGRICULTURAL UNIVERSITY

DIRECTORATE OF RESEARCH

Dr. D. ALEXANDER
Director of Research

Main Campus
KAU Post-680 656
Thrissur-Kerala

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FOREWORD

Watershed management has a key role to play in the overall development of rainfed farming areas in India. A national programme titled "National Watershed Development Programme for Rainfed Agriculture"(NWDPRA) was launched in 1990 by the Ministry of Agriculture and Cooperation after realizing this need. The project endeavored to conserve the precious rainwater and topsoil in rainfed areas by adopting a farming system approach based on watershed management principles. Considering the magnitude of public fund involved in the programme and the multi-agencies participating, it is high time to assess the impact of the schemes and to take stock of the ground realities.

It is in this context that the Government of Kerala sanctioned a Project on "Impact Evaluation study of NWDPRA scheme implemented during Ninth Five Year Plan", which was undertaken by the Department of Agricultural Economics, Kerala Agricultural University. The study focused on impact of the programme using a set of impact indicators. I am really happy to note that the scientists are bringing out the findings in the form of a concise final report.

I take this opportunity to congratulate all the scientists involved in the conduct of the project for their sincere efforts to complete the project in a most objective manner within a reasonably short period of time. I wish that this publication proves highly useful to administrators, planners, researchers and grass root level extension workers concerned with watershed management.

(D. Alexander)

PREFACE

The study entitled "Impact Evaluation Study of NWDPRA Scheme implemented during IXth Five Year Plan" was undertaken to provide a comprehensive evaluation of the multi-dimensional impact made by the National Watershed Development Programme for Rainfed Agriculture (NWDPRA) in Kerala during the Ninth Five Year Plan. The study attempts to evaluate the impact of the programme in a most objective manner, using a set of impact indicators. The evaluation of such a multi resource, multi disciplinary, and multi agency programme can be successfully undertaken only with the good help, support and co-operation from the officers of the various implementing agencies. We wish to place on record our deep sense of gratitude to all the officials of the Departments of Agriculture, Soil Conservation, and the Watershed Committee of the concerned watersheds for the wholehearted support provided at the various stages of the work.

The comprehensive data required for the project was collected by utilizing the services of Ms. Rani.G, Mr.Anoop.P, Mr.Gireesh.S, Ms.Tintu Baby, Mr.Mujeebur Rahiman, Ms. Anupama, K.N, Ms. Subhasree. K and Ms. Asha Abraham. It was these Junior Research Fellows who have borne the brunt of exhaustive data requirement. We are also obliged to Ms. Divya, K.M, Mr. Deepakumar.V.S, Ms. Sreeja.K.G, Ms. Sreela.P. and Ms. Deepa.U.V, for contributing more than being mere Research Associates of the project.

Our thanks are also due to the Sri.V. Aboobaker Deputy Director, Department of Soil Conservation for the valuable help rendered in the consolidation of the draft report. We would like to place on record our gratitude the Associate Dean, College of Horticulture, and the Director of Research, Kerala Agricultural University for extending all facilities required for the smooth completion of the project. The financial assistance from Government of Kerala is also gratefully acknowledged.

Dr.E.K.Thomas
Principal Investigator

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CHAPTER 1
INTRODUCTION

Rainfed agriculture across the world is characterized by low productivity, degraded natural resources and widespread poverty. This poses the challenges of sustainable resource management of a magnitude never faced before. Among them, the major ones are declining per capita availability of land and water resources on the one hand, and rapid ecological degradation on the other hand. Soil erosion has reached crisis proportion as India's cropped land is losing productivity because of the topsoil being washed away faster than natural forces that can replace it. Most soils are non renewable within human life span as nature takes a long period of 300-1000 years to produce an inch of soil. Dhruvanarayana and Rambabu (1983) estimated that a total of 5334 million tonnes of soil (16.35 t/ha) is being annually eroded from the country's geographical area, and about 50 per cent of cultivated land is affected by soil erosion. This estimated annual average loss of 16.35 t/ha of topsoil is far above the accepted tolerable limit of 4.5-11.2t/ha. The country's rivers carry approximately 2052 million tonnes (6.26 t/ha). Out of this, about 480 million tonnes (29 per cent) of soil is deposited in various reservoirs and 1572 million tonnes are washed into the sea every year.

In Kerala, out of 22.4 lakh ha of cultivated land in the State, around 9.0 lakh ha is prone to soil erosion, which constitutes 40.18 per cent of the total cropped area (Government of Kerala, 2004). Due to the predominance of small and fragmented holdings, massive interventions on a contiguous basis shall form the central strategy of any conservation measures. That is how an integrated soil and water conservation programme on watershed basis assumes significance. The National Watershed Development Project for the Rainfed Areas (NWDPRA), a Centrally Sponsored Project, is implemented in Kerala from 1990-91 onwards. During the Ninth Plan, the project was implemented in 74456 ha, covering 114 watersheds, at an outlay of Rs.25.69 crores (Government of Kerala, 2004).

1.2. Watershed based rural development

Technically, watershed is a geo-hydrological entity. It is an area of land from which the run off flows through natural drains as gullies, streams or rivers. Therefore, area of land falling on a watershed is hydrologically interrelated in that it has its own natural drainage system. Sustainable land and water development is the primary objective in any watershed programme. However, *watershed management* has come to mean different things to different people. That is why the Food and Agriculture Organization of the United Nations defined watershed management as " the process utilization, development and conservation of land, water and forest resources for continually improving livelihoods for households and communities in a given hydrologically independent geographical area"(FAO, 1997).

While *watershed development* programmes are not new in India, *watershed based rural development* is a relatively new concept. It aims to promote socio-economic development through optimum utilization of natural resources like land, water, vegetation, that mitigate the adverse effects of drought and unemployment, restoration of ecological balance at micro level through easily and affordable low cost technologies and improvement in socio-economic conditions of the society. Under this approach, the basic unit of development is a watershed. Therefore, water is an integrator of all the resources in the hydrological unit, and it shall aim at conservation, utilization and efficient management of not only agricultural lands, but forest and other non arable lands along with other natural resources in the planning unit (FAO, 1977; Dhruvanarayana *et al* , 1997).

Under the Ministry of Rural Development of Government. of India, watershed development projects have been taken up under different programmes. The Drought Prone Area Programme (DPAP) and the Desert Development Programme (DDP) adopted the watershed approach in 1987. The Integrated Wasteland Development Project (IWDP) taken up by the National Wasteland Development Board in 1989 also aimed at developing wastelands on a watershed basis. Later, this programme has been brought under the Department of Wasteland Development in the Ministry of Rural Development. The Ministry of Rural Development issued 'Guidelines for Watershed Development' in 1994 (Government of India, 1994). From 1-4-2003 onwards, instead if the three schemes of DPAP, DDP and IWDP, a comprehensive project called *"Hariali"* under the Ministry of Rural Development, which follows watershed development approach became operational. The new *Hariali* project is based on the revised common guidelines of 2000.

1.3. Objectives of the watershed development programmes

Watershed development programmes mainly aim to generate such activities, which would have *in situ* conservation of as much precipitation as possible in soil profile; and, collection, storage and reuse of such harvested water according to land capabilities. The ultimate purpose of the development of watershed is to increase the economic and social well being of the participants of the basin in particular and of the nation as a whole. The declared objectives of watershed development programmes in India are:

- Utilize the available land to its maximum productivity by adopting various/suitable measures that are user friendly and as per the land use capability, without any environmental degradation
- Use eco-friendly measures to maximise productivity per unit area, per unit time and per unit of water to meet the food, fodder and fuel requirements of the people living in the watershed

- Conserve as much rainwater as possible in the place where it falls, without disturbing the natural hydrological system, and increasing the ground water level in that process and maintaining it for sustainable use
- Prevent soil erosion and reduce sedimentation by means of suitable soil and water conservation measures
- Provide training and build capacity of the primary stakeholders through participatory approaches so as to evolve a demand driven action plan for sustainable watershed development
- Encourage contribution in the 'works' of the watershed development programme
- Improve the infrastructural facilities in the watershed
- Increase the level of income and status of the people living in the watershed
- Address the livelihood support systems, particularly of the landless and women, and
- Finally, to evolve monitoring and evaluation methods to make the programme transparent, flexible and cost effective. Community based organizations (CBO's) and the people shall be the partners in this endeavor.

1.4. Historical background

India's water policy since Independence consisted of the construction of huge dams and reservoirs, distribution of canals, etc., which were in the form of major and medium irrigation works. The role and significance of traditional sources of water like ponds, tanks, small rivers and similar water bodies was by and largely neglected. The earlier efforts at soil and water conservation can be traced to the **Soil Conservation Works** in the catchments of River Valley Projects in 1962-63. The main objective of the scheme was to maintain the life of reservoirs. The ownership of the scheme was with the central and state governments, which funded the scheme. However, only in 1982, watershed development was adopted as a national strategy for integrated and comprehensive development of rainfed areas along with the launching of the new 20-point programme. In 1983, "Pilot Project for Propagation of Water Conservation/Harvesting Technology for Rainfed Areas on Watershed Basis" was initiated in 19 districts in 15 States.

The mid term review of Seventh Five-Year Plan recommended a massive watershed development programe to be launched in the country with the twin objective of increasing land productivity and to contain land degradation. Thus, the National Watershed Development Programme, covering 99 districts in 16 states of the country was taken up for the

implementation. The programme titled "National Watershed Development Programme for Rainfed Agriculture (NWDPRA)" came into force with the Government Order No.6-13/ 85-CA dated 3rd July, 1986 for the years 1986-87 to 1989-90 at a total cost of Rs.239 crores. Based on the experience, a restructured NWDPRA (National Watershed Development Programme for Rainfed Areas) was launched during the Eighth Five Year Plan, covering 25 states. After three years of implementation, a Committee of Secretaries and Working Group of Planning Commission was appointed to review the guidelines prepared during 1986. A revised set of guidelines came into existence in 1990, entitled *Watershed Areas Rainfed Agricultural Systems Approach* (WARASA) (GOI,1991).

Under this approach, the objectives of watershed development were :

- Conservation of the availability of food, fodder, fuel, timber and biomass
- Create an influence on employment in the sector by making available additional work opportunities to the weaker sections, landless labourers and tribals
- Overall improvement in adoption of technology, environmental conservation, income opportunities and resource availability
- Create conditions for reduction of income inequality, and
- Create awareness among the beneficiaries and ensure their participation through the stages of its implementation

The approach and strategy to sustainable watershed management emphasized three things, viz., information, involvement and joint decision making by all stakeholders. It was felt that when the communities were part of a development partnership, there was greater ownership and sustainability of the project.

1.4. Objectives of the study

The National Watershed Development Programme for Rainfed Areas (NWDPRA) implemented in Kerala during the Eighth Five Year Plan encompassed watershed based soil and water conservation projects, special components projects and scheduled tribe sub projects. The project aims at conservation of rainwater and soil through various engineering and vegetative measures and production of biomass by promoting scientific land use planning and increasing production of food grains, horticultural crops, fodder and fuel wood on a sustainable basis. NWDPRA projects were continued during the IXth plan also and is being continued in the Xth plan. However, it is high time that impact evaluation of already implemented projects is conducted to take stock of the situation and go for corrections, if any. It is under this background that the impact evaluation of NWDPRA schemes

implemented in selected blocks during the IX th Five Year Plan was undertaken with the following specific objectives:

- To evaluate the impact of NWDPRA implementation in Kerala in terms of physical achievements, agronomic changes and socio-economic benefits
- To assess the changes in land use pattern and cropping pattern in the area
- To examine the income and employment generation from agriculture and allied activities
- To analyze the constraints experienced in implementation of the programme

1.5. Limitations

Any multi-faceted programme of this nature requires benchmark information on the various aspects of the project area and the socio-economic status of the stakeholders to make meaningful comparisons. A serious limitation faced by the evaluation team was lack of such a base line data. Concurrent evaluations are also very useful to identify deviations, and to carry out mid-course corrections. It is not known whether such concurrent evaluations have been carried out in this case. No such reports were made available to the evaluation team for reference. Therefore, the team could not assess mid-course transitions also. Another limitation faced by the team was the unavailability of reliable secondary data in certain watersheds.

1.6. Organization of the report

The report is organized under five Chapters. Introductory remarks about the background of the project are given in Chapter1. The methodological framework used in the study and working definitions are presented in Chapter 2. Chapter 3 describes the study area. Chapter 4 focuses on the impact evaluation, while Chapter 5 summarizes the main findings and recommendations based on them. □

CHAPTER 2
METHODOLOGY

As economic development is always accompanied by an increase in water use, proper management of water resources is an essential component of sustainable development. Proper watershed management entails triple benefits to humankind. Besides, maintaining the productive capacity of the natural resources in the watershed area, it arrests the degrading processes also. Thirdly, watershed management is more cost effective than rehabilitation of degraded watersheds. The evaluation study was undertaken in *Thiruvananthapuram, Pathanamthitta, Idukki, Thrissur, Palakkad* and *Kannur* districts by keeping these principles in mind.

2.1. Sampling Design

Watersheds having an area of 500-1000 ha were listed from the selected districts and a total of eight watersheds were selected from the list in consultation with the officials of the State Department of Agriculture and the project implementation agencies. The selected watersheds are listed in Table 2.1.

Table 2.1.List of watersheds selected for evaluation of NWDPRA during Ninth plan

District	Watershed	Block	Panchayath	Geographic area (ha)	Effective project area (ha)
Thiruvana-nthapuram	Pallichal	Nemom	Pallichal Killiyoor	845	790
Pathana-mthitta	Naranganam	Elanthur	Naranganam Kozhencherry	1475	678
Idukki	Kunhithanny Uppukandam	Adimali Kattappana	Bison valley Irattyar, Kattappana	1170 1007	1049 860
Thrissur	Elanad	Pazhayannur	Pazhayannur	2140	1360
Palakkad	Pulikkalthodu	Srikrishna-puram	Vellinezhy, Sreekrishna-puram	950	878
Kannur	Charal Pothankandam	Iritty Payyammur	Ayyankunnu Peringome Vayakkara	726 1078	714 1054

They were *Pallichal* watershed from *Thiruvanathapuram* district, *Naranganam* watershed from *Pathanamthitta, Kunjithanny* and *Uppukandam* watersheds from *Idukki, Elanad* watershed from *Thrissur, Pulikkalthodu* watershed from *Palakkad, Charal* and *Pothenkandam* watersheds from *Kannur*.

Another set of eight adjoining watersheds, which were similar in agro climatic conditions, soil type and topography – but did not receive treatment under the Ninth Five Year Plan were also identified as control (for 'with and with out approach') for comparison with the study area. All the major components of watershed programmes were identified based on discussion with the implementing agencies and *Mitra Kisans* of the selected watersheds areas.

2.2. Collection of Data

The secondary data required for the evaluation was collected from records maintained by the Implementation Committee of the respective watersheds.

The primary data was collected by the interview method, using a structured, pre-tested schedule of enquiry (Appendix - I). For collecting primary data, the respondents were categorized as beneficiaries and non beneficiaries (control group). The list of beneficiaries was collected from the Implementation Committee of the respective watersheds. A beneficiary was operationally defined as any individual benefited by the watershed project for better living and non beneficiary was defined as any resident in the non project area defined above, who did not receive any benefits of the project because the watershed development programmes was not implemented. From each watershed, 50 beneficiaries were selected randomly. 25 respondents were selected from the non-project area for comparing the impact as a control group. The approach of "with" and "without" the project had to be adopted as bench mark information "before" the project implementation was not available with respect to all impact indicators.

The multiplicity of goals and activities suggest that a single indicator cannot be used to gauge the impact of the programme. Hence, the most feasible approach was to compare the performance using a set of indicators, which represented the various broad activities covered in the project. The following impact indicators were used to capture the multidimensional impact of the programme:

- Arable land
  - Changes in ground water status
  - Changes in green cover and microclimate
  - Changes in soil fertility status
  - Sustainability of conservation measures adopted

- Crop Production
  - Changes in productivity
  - Changes in cropping pattern
  - Changes in cropping intensity
- Non arable land
  - Impact of conservation measures
- Drainage related indicators
  - Efficiency of stream bank stabilization
  - Changes in water flow
  - Quality of different items work
- Socio-economic indicators
  - Changes in income generation
  - Changes in employment
  - Impact on women
  - Impact on landless people
  - Impact on family asset, education and domestic expenditure pattern
- Ecological indicators
  - Reduced soil erosion
  - Enhanced water harvesting
  - Changes in fire wood availability
- Livestock based indicators
  - Changes in livestock population
  - Changes in fodder production and availability
- Institutional indicators
  - Effectiveness of watershed community in project planning and implementation
  - Effectiveness of training programmes

2.3.Period of Study

The primary data pertains to two periods, viz., the pre project period (1998-99) and the post project period (2003-04). As both observations were measured in current prices, the Agricultural Wholesale Index (AWI) was used as a deflator so that comparisons could be made at the 1998-99 constant prices.

2.4 . Working Definitions and Concepts used in the Study

2.4.1. Watershed

Watershed can be defined as a geo hydrological unit, or a piece of land that drains at a common point.

2.4.2. Watershed development

It is defined as an integrated approach of conservation of land, soil, water and biomass for the ultimate benefit of humankind in a given hydrologically independent geographical area.

2.4.3. Operating area

The operating land was defined as the total land possessed by the sample respondents excluding land for non-agricultural purposes.

2.4.4. Net cropped area

Net cropped area has been defined as the total area used for cultivation of various crops in a particular year.

3.4.5. Gross cropped area

It is defined as the sum total of net cropped area and area sown more than once in a particular year.

2.4.6. Cropping pattern

The cropping pattern is expressed as the percentage share of each crop in the gross cropped area at a particular point of time.

2.4.7. Labour use pattern

The labour use pattern with respect to major crops grown by the respondents was collected. The concept of man-day used here relates to 8 hours work per day and the wage rate prevailing in the area was taken for converting the physical units into monetary units.

2.4.8. Cost of cultivation

Farm expenses incurred in carrying out major operations in the cultivation of crops were considered for calculating the cost of cultivation.

2.5 . Review of Literature

Many studies have been undertaken in various parts of India on the impact of National Watershed Development Projects. This section attempts a brief review of the relevant studies.

Sharma and Garg (1978) conducted an ex-ante appraisal of the *Kandi* watershed in Punjab, and concluded that the project provided employment to 4000 persons annually, besides increasing the productivity of the land resources. The Net Present Worth of the project was positive, and the Benefit-Cost ratio was more than one at 12 per cent discount rate. The sensitivity analysis revealed that the IRR was about 11 per cent.

A comparative study of cost and returns of the watershed unit in Ahmed Nagar district of Maharashtra by Mahundule *et al* (1989) based on pre and post project periods indicated that the proportion of irrigated area in the watershed increased from 19 per cent to 23 per cent after implementation of the programme. Cropping intensity also increased by 15 per cent. The benefit cost ratio for the programme was 1.28 with an internal rate of return of 12.33 per cent.

Suryawanshi *et al* (1991) assessed the economic impact of *Kolhewadi* watershed development programme in Maharashtra, and concluded that the soil and water conservation structures were beneficial in increasing ground water table. The number of effective wells increased from 34 to 74. There was a shift in cropping pattern, with the area under pulses, oil seeds, cash crops and horticultural crops recording an increase after the implementation of the project.

Padmaiah *et al* (1994), after studying the hydrological, crop production and socio economic changes that occurred through resource conservation in *Cheinnatekur* watershed in Andhra Pradesh, and *Joladarasi* watershed in Karnataka concluded that interventions such as diversion drains, graded bunding, rock filled dams, ponds, and *nala* bunds showed a positive impact on the runoff, soil loss and productivity of the major crops.

Increased cropping intensity, crop productivity, income, increased availability of fodder and improved ground water status were reported by Singh *et al* (1995) from *Udaipur,* Shiyni and Vekariya (1996) from *Madhavanti* watershed of Saurshtra, Nalatwadmath *et al* (1997) from *Bellary*, Samuel (1999) from *Ahmed Nagar* , Narayana and Prahalladiah (1999) from *Relegan Siddhi* of Maharashtra, Kumar *et al* (1999) from *Bareilly* district of Uttar Pradesh and Chandrakanth and Diwakara (2001) from *Haikal* watershed in *Chitradurga* district of Karanataka, and Sripadmini *et al* (2001) from *Venkateshpura* and *Taarehalla* watersheds in *Chitradurga* district of Karanataka.

Similarly, a number of works reported that the economic impact of watershed development programmes was translated into favorable benefit: cost ratio. Prominent among them are Gregerson *et a l*(1987), Singh *et al* (1995), FAO (1997), Dhruvanarayana *et al* , (1997), Nalatwadmath *et al* (1997), Samuel (1999), Farrington *et a l* (1999), Sripadmini *et a l* (2001), Patil and Phuke (2002), Sastry *et al* (2004) and Shaw *et a l*(2004).

Gaur *et al* (1998) in their study on ground water modeling study using finite difference method in assessing ground water recharge reported that the recharge was 6.0 ha-m per year. It was also found that the soil and water conservation measures like contour and staggered trenches, *nala* bunds, cement plugs, loose bolder, check dams, contour bunds, graded bunds, *nala* training works, diversion drains when implemented on watershed basis made definite impact on ground water recharge.

Singhal (1999) found that people's participation in watershed management reduced the cost of the project, increased the benefits to people participating in the programme, decreased the perpetual dependence of the people on the government, thereby making the programme self sustaining in the *Shivalik* foot-hills of Haryana.

According to Sastry (1997), the average cost of watershed treatment in Karnataka was Rs.4000 per ha at the 1997 prices, which was to provide an incremental yield increase of 50 per cent. Against this, the cost of providing major irrigation treatment worked out to Rs.1 lakh per ha, which was to provide an incremental yield increase of 400 per cent. It implied that the relative cost of watershed to major irrigation was in the ratio of 25:1, while the relative return was in the ratio of 8:1. He argued that this should provide the economic rationale for watershed development programmes, which were much more cost effective than irrigation development.

Chandrakanth and Diwakara (2001) evaluated the synergistic effects of watershed treatments on groundwater recharge in *Haikal* watershed in *Chitradurga* district of Karanataka. The study revealed that one major positive externality of watershed development programmes was the benefit of groundwater recharge, resulting in zero well failure after the programme. As a result, 78 per cent of the cropped area was devoted under onion, a water intensive crop. The negative externality on account of well interference also came down drastically after the implementation of the programme.

The relative economic performance of watershed development projects under governmental and non-governmental mode of governance was carried out by Sripadmini *et al.* (2001) in V*enkateshpura* and *Taarehalla* watersheds in *Chitradurga* district of Karanataka. It was observed that eventhough the cost of supervision of governmental mode of governance

was higher, the transaction cost per beneficiary and per unit cultivated area were lower in government implemented watershed development programme.

2.6 . Analytical Framework and Tools

The collected data was tabulated and analyzed in accordance with the objectives of the evaluation. The socio economic characteristics of the sample farmers and changes in the selected impact indicators of watershed development programme were analyzed for the different classes using arithmetic mean and percentages. The input wise cost of cultivation of major crops were estimated on per hectare basis in both pre project and post project period, compared with the control plots to capture the changes.

Organic carbon of the soil was estimated for the soil samples collected from both the beneficiaries as well as the non-beneficiary groups. The estimation was carried out using wet digestion method as suggested by Walkley and Black (1934). The soil organic matter content was estimated by the formula :

Organic matter content = Organic carbon * 1.724

The analysis of constraints was carried out by the scoring method. The response of each constraint was obtained on a five-point continuum as most important; important; somewhat important; less important and least important. They were assigned the scores of 5, 4, 3, 2 and 1 respectively. For each constraint, the frequency of response under each category was multiplied with its respective score and added to get a cumulative score for that particular constraint. The ranking of the constraints were carried out based on the cumulative score thus obtained.

CHAPTER 3
THE AREA UNDER STUDY

Kerala state falls under five different agroclimatic zones, Northern zone, Southern Zone, Central Zone, High Altitude Zone and Problem Area Zone. The Northern Zone is comprised of *Kasargod, Kannur, Kozhikode* and part of *Malappuram* districts and the southern zone includes *Thiruvanatnthapuram, Pathanamthitta, Alappuzha* and part of *Kollam* and *Kottayam* districts. The districts of *Palakkad* and part of *Malappuram, Thrissur, Ernakulam* and *Kottayam* come under the central zone. The high altitude zone comprises the district of *Wayanad* and *Idukki*.The problem area zone bears in its part of *Malappuram, Thrissur, Ernakulam, Kottayam, Pathanamthitta* and *Alappuzha* districts. All the above zones distinctly vary in the topographical and hydrological phenomena. In the Eighth Five Year Plan a number of watershed development projects have been implemented in Kerala sponsored by different agencies in all the districts depending on the variations in topographical and hydrological situations and this was carried out during the Ninth plan also.

Out of the 14 districts where project has been implemented, 6 districts were selected for the study. The watersheds selected for assessment were *Pallichal* watershed from Thiruvanathapuram district, *Naranganam* watershed from Pathanamthitta, *Kunjithanny* and *Uppukandam* watersheds from Idukki, *Elanad* watershed from Thrissur, *Pulikkathodu* watershed from Palakkad, *Charal* and *Pothenkandam* watersheds from Kannur.

3.1. PALLICHAL WATERSHED

Pallichal watershed is located in *Thiruvanthapuram* district. *Thiruvanthapuram* is the southern most district in the state coming under the southern agro climatic zone of the state. The district includes one City Corporation, 4 Municipalities, 12 Blocks and 84 *panchayats*. The population of the capital city is 524006 and density of population is 6993/ km^2. The total population of the district is 29,47,000.The density of population of the district is 1344/km^2.

3.1.1. Agroclimatic characteristics of Pallichal watershed

The watershed belongs to the *Karamana* river basin of Thiruvanan=thapuram District. The watershed drains to the *Vellayani* Lake and then to the Karamana river. Pallichal watershed comes under the block *Nemom* and *Pallichal* villages of *Pallichal* and *Killiyoor Panchayaths* (Table 3.1).

The total geographical area of the watershed is 845 ha. Out of this, 55 ha of land is under homestead, roads, canals, buildings, rocks, etc. The area readily available for the project activities is 790ha. About 10 ha of land under homestead can be utilized for backyard horticulture and homestead kitchen gardens. Thus the total effective project area of the watershed is 800 ha (790+10).

The location of the *Pallichal* watershed is between 8'25 45" and 8 27' 18" North latitude and 76 59' 28" and 77 2' 35" East longitude. The watershed is about 10 Kms southwards to Trivandrum city in Trivandrum- Neyyattinkara route. About 540 hectares of the watershed is found below a depth of about 15 meters. In other areas the water table is at a higher level. The hydrology of the watershed is mainly under the influence of the monsoon showers. There are about 20 ponds in the watershed, which needs to be protected and maintained. The annual rainfall received in the watershed is 2095mm. The highest rainfall received in the last 10 years was 2275mm in the year 1987-88. The average annual rainfall in the watershed area is 2095 mm, and the northeast and southwest monsoon contribute to about 90 per cent of the total precipitation.

The main crops grown are banana, coconut, tapioca, tubers, vegetables etc. There are some rubber plantations in the watershed area. But the area under rubber isnegligible.

Table 3.1. Physiographic features of Pallichal watershed

Sl.No	Particulars	Features
1.	District	Thiruvanthapuram
2	Block	Nemom
3	Panchayath	Pallichal and Killiyoor
4	Latitude and longitude	8'25 45" and 8 27' 18" North latitude and 76 59' 288" and 77 2' 35" East longitude
5	Total geographical area of watershed	845 ha
6	Effective Project area	790 ha
7	Annual rainfall	2095 mm

The total cattle population is 2800. There are 26 buffaloes, 217 goats. Poultry and duck rearing are very informal. Breeding by natural service is not promoted in the area as a general policy. The livestock management in the area is neither completely scientific nor systematic

3.1.2. FamilyComposition

The watershed consists of 4780 families having a population of 1531 of which the male population is 7524 and the female population is 7787 (Table 3.2). The female population almost abstain from agriculture and allied activities. Kitchen gardening or floriculture is not a general concern for the women community in the watershed. About 90 per cent of the population is literate. The male literacy percentage is 93 per cent, while the female literacy is 87 per cent. A considerable portion of labourers migrates to nearby cities in search of job in the construction and other sectors.

Table 3.2. Family size and composition

Sl.No	Particulars	Number
1	Number of families	4780
2	Male	7524 (47.98)
3	Female	7787 (49.45)
4	Total	15311 (100.00)

(Figures in parentheses indicate percentage to the respective totals)

3.1.3. Soils

Four soil series have been identified in the watershed and presented in Table 3.3. They are the *Vizhinjam* series, *Neyyattinkara* series, *Marukil* series and *Amaravila* series. Productive potential of the soils range from medium to high. The soil depth varies from 1 m to 1.5 m. The surface soil texture ranges from gravelly loam to sandy clay loam. The pH ranges from 5 to 6.

The geology of the watershed reveals that the crystalline rocks found in the region belong to *Khondallite* group which are predominately of *syliminate* genesis; *Quartz Omicracline, feldspar, Horneblende, Muscovite* and *Biotite mica. Quartz pegmatite* veins are intrusive in the region.

Table 3.3. Soil types

Sl No.	Soil series	Area (ha)
1	Vizhinjam	541.28
2	Neyyattinkara	115.12
3	Marukil	178.38
4	Amaravila	5.12
5	Miscellaneous	4.00

3.1.4.Land capability classification

The system of land capability classification aims at classifying land on the basis of its potentialities and limitations for sustainable agricultural production. The soils are grouped at two levels of generalization, such as land capability classes and land capability sub-classes within the classes. Land capability classes indicate the intensity of limitations while the sub-classes indicate the kind of limitations. The land capability classification of the watershed is presented in Table 3.4.

Table 3.4.Land capability classification

Sl No.	Soil series	Area (ha)
1	II	183.50
2	III	428.44
3	IV	233.6

The area in the watershed is grouped into four capability classes and four capability sub-classes as shown above. The major kinds of limitations identified are erosion, soil limitation, climatic limitations and wetness.

3.1.5.Drainage and slope

The watershed has sloppy terrain. More than 650 ha of the area are featured with slopes more than 8 per cent. The drainage system is of *dendritic* type. The main drainage line, the *Pallichal thodu* is about 7.8 kms long. About 40 sub-drains discharge into the

main drain. The total length of the drainage lines in the watershed is 19 kms. The main drain originates at *Naruvamood* and drains at *Vellayani* Lake. The banks of the drainage lines in the middle and lower reaches are badly affected by the flow. Breaches and collapses are seen at many locations of the drain banks. The average depth is 2 metres.

3.1.6. Soil erosion

Soil erosion is a general problem in the watershed. Around 60 per cent of the arable land shows medium rate of soil erosion. High rate of soil erosion is noticed at certain pockets with specific topographic and drainage characteristics. Low erosion is featured in nearly22 per cent of the eroded area as shown in Table 3.5.

Table 3.5. Area under soil erosion

Sl.No.	Erosion	Area(ha)	As % to total
1	High	152	17.94
2	Medium	507	59.86
3	Low	188	22.20
	Total	**847**	**100.00**

3.1.7. Vegetation

Medium level of vegetation is prevalent in the watershed area. Inadequacy of cover crops in the area invites special attention. The frequent tilling of lands cultivated with coconut and tapioca enhances erosion. The vegetation is inadequate to support the watershed community in meeting their food, fodder, fuel, and timber needs.

3.2. NARANGANAM WATERSHED

Naranganam watershed is located in *Elanthoor* block of *Pathanamthitta* district. It comprises an area of 1475 ha and is located in Naranganam and Kozhenchery villages of Kozhenchery taluk. It lies between 9' 17' 42" and 9' 20' 16" north latitude and 76'43" and 76'46'42" east longitude. Elevation of the watershed ranges from 40-182m above MSL. The physiographic features of *Naranganam* watershed is presented in Table 3.6.

Table 3.6. Physiographic features of Naranganam watershed

Sl.No	Particulars	Features
1	District	Panthamthitta
2	Block	Elanthoor
3	Village	Naranganam and Kozhenchery
4	Latitude and longitude	9' 17' 42" and 9' 20' 16" north latitude and 76'43" and 76'46'42" east longitude
5	Total geographical area of watershed	1475 ha
6	Effective project area	678 ha
7	Dry land	1241.5 ha
8	Wet land	191.5 ha
9	Road, streams, buildings	42 ha
10	Annual rainfall	3062mm

3.2.1. Agroclimatic characteristics of *Naranganam* watershed

Naranganam watershed comprises of midlands (20-100m above MSL) and mid uplands (100-300m above MSL). The area is drained by several streamlets, which join to form the main stream, and finally join the *Pamba* River. The watershed has *dendritic* drainage pattern. The area enjoys a humid tropical climate with mean annual temperature of 27^0c and average rainfall of 3062mm.

3.2.2.CroppingPattern

Almost the whole area of watershed is under intensive cultivation. Rubber occupies major portion of the area. Coconut based cropping pattern is practiced in the rest of the area. Inter crops include perennials like cocoa, nutmeg, and pepper; annuals like banana, tapioca, yams and seasonal crops like pulses and vegetables. Paddy is cultivated in the valley portions and low-lying areas of the watershed.

3.2.3. Soils of the Area

The *Mallasseri, Ayroor, Adoor, and Kumaranperur* soil series were identified in the area. The details are presented in Table3.7.

Table 3.7. Soils of the Area

Sl.No	Physiography	Soil Series	Area (ha)	As % to total
1	Mid land valleys	Mallasseri series	191.5	13.37
2	Mid land	Ayroor series	560.	39.11
		Adoor series	33.6	2.35
3	Mid upland	Kumaranperur series	647.0	45.17
		Total	**1432.20**	**100.00**

The *Mallasseri* soils are developed on alluvial deposits and occur on nearly level to very gently sloping lands. They have very dark grayish brown to yellowish brown acidic sandy loam to sandy clay loam, with Brownish A horizon and yellowish brown loam to clay B horizon. The soils are imperfectly drained with moderate permeability. These soils have medium fertility status with good water holding capacity. Paddy is mainly cultivated in these soils. Drainage impedance is the main problem of these soils, which leads to crop loss during monsoon season. Liming is done to correct acidity of these soils, and they respond well to management practices.

The *Ayroor* soils have dark reddish brown to dark brown loam to clay loam acidic A horizon, followed by yellowish red to dark reddish brown clay loam to clay acidic B horizon. They were developed on river alluvium, and are poorly drained with moderate permeability. They occur on gently sloping lands to level lands along the riverbanks. They have medium fertility status with medium nutrient holding and water holding capacity. Coconut, arecanut, sugarcane and banana are the main crops cultivated on these soils. These soils have fairly high water table and are subjected to periodical flooding. They respond well to management.

The *Adoor* soils have reddish brown to yellowish brown acidic gravelly loam to gravelly clay loam A horizon, overlying yellowish red to strong brown acidic gravelly sandy clay loam to gravelly clay B horizon. They have developed on laterite and occur on gently sloping lands to steep lands. These soils are gravelly and porous, and have medium

water holding capacity. These soils have low fertility status, and are cultivated with crops like rubber, coconut, tapioca and fruit trees. The slope gradient ranges from gentle to steep and the excess gravel content. They induce erosion, and therefore needs careful soil conservation measures. Garden crops suffer due to drought during the summer.

The *Kumaranperur* soils have dark reddish brown to brown strongly acidic loam to gravelly clay loam A horizon and dark reddish brown to yellowish red gravelly silty loam to gravelly clay acidic B horizon. They were developed on *granite* genesis. These soils are excessively drained, and have moderate permeability. They occur on steep to very steepy lands, and therefore highly susceptible to erosion. They have medium fertility status and have high water holding capacity. Rubber is the main crop cultivated. Drought is experienced during summer months. They respond well to management but require proper soil and water conservation measures. Nearly 45 per cent of the watershed area is covered under this soil series.

3.2.4. *Land capability classification*

Four land capability classes have been recognized in the watershed. Classes from V to VIII are not suitable for cultivation due to different kinds of limitations and are recommended for permanent vegetation and for other non-agricultural uses. In the present case, class II, III, IV and VI were observed. These along with their sub classes are given below:

Class II w

An area of 191.5ha under *Mallasseri* series comes under this class. These are good cultivable lands with deep soil occurring on very gently sloping land subject to wetness or overflow during rainy season. Wetness and seasonal flooding during monsoon season and moisture stress during summer are the main limitations.

Class IIe

An area of 180 ha under *Ayroor* series comes under this class. These are good cultivable land with deep soil occurring on very gently sloping lands. Seasonal flooding during monsoon season and moisture stress during summer are the main limitations.

Class III e

An area of 477.8 ha under *Adoor* series and Ayroor series comes under this class. They are moderately good cultivable land having moderately deep soil occurring on gently sloping to moderately sloping lands subject to slight to moderate erosion.

Class IVe

An area of 222.7 ha under *Kumranperur* series and *Adoor* series comes under this class. These are moderately deep to deep soil occurring on strongly sloping to moderately steep to steep lands subject to moderate erosion hazards.

Class IV es

An area of 347.3 ha under Kumranperur series comes under this class. These are moderately shallow to moderately deep soil occurring on strongly sloping to moderately steep to very steep lands subject to moderate to severe erosion hazards

Class VI es

An area of 175.7 ha under Kumranperur series comes under this class. These are moderately shallow soil occurring on steep to very steep lands subject to moderate to severe erosion hazards.

3.3. KUNJITHANY WATERSHED

Kunjithanni watershed spreads over a total area of 1170 ha in the *Bison valley panchayath* of *Adimali* block in *Devikulam Taluk*. The area lies between 10 ^{0} 0' 30" and 10 ^{0} 2' 45" lat and 77 ^{0} 3' and 77 ^{0} 6' E longitude. The *Adimaly-Anachal-Kunjithanny-Pottankad* road is the main access.

Table 3.8. Physiographic features of *Kunjithani* watershed

Sl.No	Particulars	Features
1	District	Idukki
2	Taluk	Devikulam
3	Panchayath	Rajakkad
4	Latitude and longitude	North latitude at 10 ^{0} 0' 30" and 10 ^{0} 2' 45" and east longitude 77 ^{0} 3' and 77 ^{0} 6'
5	Total geographical area of watershed	1170ha
6	Effective Project area	1049 ha
7	Area under arable land	649 ha
8	Area under non arable land	500 ha
9	Elevation	700 to 2183 m above MSL

3.3.1. Physiographic features

The watershed is situated in the very steeply sloping mountain slopes with rock escarpments. The elevation ranges from 700 to 2183 m above MSL. In general the upper north and northeastern portions are very steeply sloping and the lower portion is moderately to steeply sloping. The following physiographic units have been identified in the watershed:

1. Steep to very steep rocky mountain tops with escarpments at elevation above 2000 MSL
2. Very steep rocky mountain slopes with escarpments at elevation between 1200 MSL and 2000 MSL
3. Very steep mountain slopes at elevation between 1200 to 2000 MSL
4. Very steep hill slopes at elevation between 900 and 1200 MSL
5. Moderately steep to steep rolling foot hill slopes at elevation between 900 and 1200 MSL
6. Steeply sloping foot hill slopes and mounds at elevation between 700 and 900m MSL

3.3.2. Agroclimatic characteristics of Kunjithani watershed

Of the total 1170 ha, an area of 1050 ha was found to be the effective project area. This included the cardamom plantations also. This watershed could be divided into three mini watersheds but the area being uniform in soil water relationship and geophysical, topographical and land use characteristics, taken as one unit for the convenience of management. The watershed drains to *Muthirapuzha* river, and the outlet point is *Kunjithanni*. Major part of the watershed has very steeply sloping mountain slopes with degraded areas and escarpments. The ridge line passing through *Muttanmudy* cardamom plantation forms the western boundary and northern boundary and that along *Chakkanadmala* and *Pottankad* form the eastern and southern boundary. The *Muthirapuzha* river is at the west.

3.3.3. Cropping pattern

Cardamom is the major crop of the very steeply sloping mountain slopes of *Iruttala* and *Chekkanad*. Patches of open scrub and rock exposures and escarpments are also seen. In the lower regions of *Irupathecre*, Northern part of *Pattankad* and *Mudavakkad* the major crops cultivated were pepper, arecanut and coffee. Cardamom and coconut are also cultivated in a mixed manner in these areas. Rubber is planted in some locations of *Irupathecre*.

3.3.4. Soils

The soils in the major areas of the watershed are very deep, well drained and clayey with dusky red surface and dark reddish brown subsurface. Depending upon the physiography and nature of vegetation, they show variations. Eight soil series have been identified and mapped. They are:

1. ***Amritamedu*** **series**

These are well-drained deep hill and mountain soils with moderate permeability occurring at very steeply sloping and steeply sloping rocky and stony ridges and mountaintops at an elevation above 900 m MSL. Shrubs and grasses cover these areas.

2. ***Iruttukanam*** **series**

These soils are very deep well drained mountain soils. They occur in the steeply to very steeply sloping mountain slopes with an elevation ranging from 1200 to 1800m MSL.

3. ***Mattupetty*** **series**

They are very deep well drained mountainous occurring in very steeply sloping side slopes and steeply sloping hill tops at an elevation above 1200m MSL. They have a dark reddish brown to dark brown clay loam to silty clay loam surface, and red to reddish yellow clay loam to sandy clay loam subsurface.

4. ***Kunjithanni*** **series**

These are deep well drained soils, which occur on steeply to very steeply sloping hills and mounds at elevation 600-1200m MSL. They have a dark brown to dark reddish brown clay loam to silty clay loam surface and a reddish brown to dark brown clay loam subsurface.

5. ***Vandiperiyar*** **series**

These are very deep well drained soils, occurring on very steeply sloping mountain slopes at elevation above 900 m MSL. They have dark reddish brown silt loam to silty clay loam surface, and red clay subsoil.

6. ***Nadukani*** **series**

It comprises deep well drained soils, often seen in side slopes of hilly regions. Soils in this series have dusky red to dark brown surface colour with loamy to sandy clay loam surface texture, subsurface is clay loam with red colour. These are comparatively productive soil, and hence are extensively cultivated with pepper. These soils are highly susceptible to land slides. Hence, suitable landslide prevention and management practices have to be adopted.

7. Elappara series

These are deep well drained hill soils, having a dark reddish brown to reddish brown silty loam to clay loam surface followed by a yellowish red clay loam subsurface, occurring at elevation of 900 – 1200 m MSL.

8. Adimaly series

They occur on steeply to very steeply sloping hill slopes and mounds, of the high ranges region at an elevation of 300-900m MSL.

3.3.5. Land capability classes

Four land capability classes have been identified in the watershed. They are class III, IV, VI, and VII. The distribution of area under the various land capability classes showed that 116 ha come under class III e category (9.91 per cent of the total area). 416 ha come under class IVe and 117 ha comes under class IV es. Another 111 ha are under class VI e (9.49 per cent of the total area), 347 ha are under class VI es (constituting 29.66 per cent of the total area), 17 ha come under class VII e, and 25 ha comes under class VII es.

3.3.6. Drainage and slope

Kunjithanni watershed consists of three mini adjacent watersheds which drains to the *Muthirapuzha* river at *Kunjithanni*.The three main drainage stream are originating from the north western side of *Muttanmudi, Iruttala* and north eastern slopes of *Muttanmudi* and flowing through *Muduvakkad*, and *Irupathecre*. The stream originates at a height ranging from 1200 m to 2183 m MSL and at the outlet point the elevation is 740 m to 760 m MSL. The aerial distance between the outlet point and the originating highest elevations is about 5 km. The general flow directions within the watershed area are in the southwesterly directions. These areas comprising of *Chakkanad mala, Iruttala* and *Muttanmudi* are very steeply sloping mountain slopes with rock, exposures and escarpments and the area at the lower portions like *Irupathecre* area is comparatively less steep.

Table 3.9. Slope wise distribution of area

Sl.No	Particulars	Area	Percentage to total area
1	Below 8 per cent slope	Nil	0
2	Above 8 per cent slope	1149	98.2
3	Rock out crops	21	1.8

Majority streams of the upper slopes dry up during summer and water scarcity is experienced in *Muttanmudi*, *Nellikkad* and *Iruttala* regions. As the upper slopes are very steep, the water velocity during Monsoon is very high and this causes stream bank drainage and erosion problems. Very steep slopes are used for cultivation purposes and unscientific management practices intensify the erosion problem.

3.4. UPPUKANDAM WATERSHED

Uppukandam watershed is located in the high altitude zone of *Udumbanchola Taluk* of *Idukki* District. The watershed area is spread between *Erattyar* and *Kattappana panchayaths*. It is located between north latitude at 90' 49" and 9' 49" and east longitude 77" 4' and 77" 9'. The watershed is comprised within a geographical area of 1007 ha. Out of this, 16 ha is under roads, rives, and canals, and 15 ha under homesteads (Table 3.10). The effective projects area of the watershed is 860 ha of which the area under arable land is 748 ha, and the area under non-arable land is 112 ha.

Table 3. 10. Physiographic features of *Uppukandam* watershed

Sl.No	Particulars	Features
1	District	Idukki
2	Taluk	Udumbanchola
3	Panchayath	Erattyar and Kattappana
4	Latitude and longitude	north latitude at 90 49" and 9" 49" and east longitude 77" 4' and 77" 9"
5	Total geographical area of watershed	1007 ha
6	Effective Project area	860ha
7	Area under arable land	748ha
8	Area under non arable land	112ha
9	Annual rainfall	2905 mm
10	Elevation	116m above MSL

At the lowest level of the watershed is water spread area of *Erattyar* reservoir. It is situated at an elevation of about 1116 m above MSL and it lies in the high altitude. *Mulakaramedu* watershed is in fact the upper southwestern portion drained by streams to the same drainage system at a higher location. *Mukkoromedu* watershed drains to a point near *Mathukal* and from *Mathukal* and other tributaries of *Uppukandam* watershed also joins together and flows towards north and merges with *Erattayar* reservoir.

3.4.2. Agroclimatic characteristics

The annual rainfall received is about 2905 mm. The variation in the rainfall regime is reflected in the surface water resources of the watershed. The main outlet is controlled by the intensity of rainfall at various periods. The smaller tributaries joining the main stream get dried up as the monsoon ceases. Therefore, the area experiences drought during January to May. The flow of the main stream decreases from December to May and even ceases thereafter. More than 80 per cent of the water received during monsoon is lost by run off.

The ridge line passing through *Moonnilavu* and *Chakkakannam* form the northern boundary; that through *Poorsmount* and *Anakuthi* form the eastern boundary; that through Parakkal forms the southern boundary, and the *Mulakaramedu* is the south west boundary. The northwestern boundary is the ridgeline passing through *Kurissumala*. The watershed is situated 5 kilometers away from *Kattappana* town in *Kattappana- Erattayar* route.

3.4.3.*Family size*

There are 1622 families residing in and around the watershed area and the number of female members (3308) is greater than male members (3266) (Table 3.11).

Table 3.11. Family size

Sl.No	Particulars	Number
1	No. of families	1622
2	Male	3266 (40.74)
3	Female	3308 (41.27)
4	Children	1442 (17.99)
	Total	**8016 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

3.4.3.Cropping pattern

The cropping pattern of the watershed as shown in Table 3.12. Paddy is cultivated in an area of only 4 ha, which is under single crop. Popular varieties cultivated were *Jyothi* and *Kunjukunju*. Pepper, which is the main crop in the area, is cultivated in 29 per cent of the total cultivated area. The next important crop is coconut, occupying 26 per cent of the

cultivated area, followed by coffee. The other major cash crops include cardamom, cocoa and rubber as well as other horticultural crops like mango, jack, *gauva*, papaya, pineapple and *sapota*.

Table 3.12. Cropping pattern of Uppukandam watershed

Sl.No	Crops	Area (ha)
1	Pepper	215 (28.75)
2	Coconut	196 (26.21)
3	Coffee	92 (12.31)
4	Ginger	22.5 (3)
5	Paddy	4 (0.01)
8	Miscellaneous	218.5 (29.22)
	Total	**748 (100)**

(Figures in parentheses indicate percentage to the respective totals)

Most households in the watershed area reared poultry. It represented 62 per cent of the total livestock population. About 12 per cent of the total livestock population was cattle while 23 per cent of the total livestock population represented goats.

3.4.3. Vegetation

Many of the climax species such as *Calophylluma clalums* , *Cassia auriculata* etc are found in the watershed. Grass species like *Guinea* grass, *Cynodon dactylon* and *Bermuda* grass found in the watershed have importance from the conservation point of view. *Cyprus rotundus, Melia azadirachta, Ocimum sanctum, Sida cordifolia* etc are the common medicinal plants found in the watershed area. Indian rose wood, *Tectona grandis* etc which are in the watershed has high timber value. Guinea grass, *Cynodon dactylon,* Congosignal, cowpea etc are the common grass species found in the watershed having fodder value.

3.4.4. Soils

Four major soil series are identified in the watershed. They are:

1. ***Amritamedu*** **series**

   These are well-drained deep hill and mountain soils with moderate permeability occurring at very steeply sloping and steeply sloping rocky and stony ridges and mountaintops at an elevation above 900 MSL. Shrubs and grasses normally cover these areas.

2. ***Erattyar*** **series**

   These are very deep, imperfectly drained clayey oils occurring in the narrow valley between steeply slopping ridges and hills, at elevation ranging from 600-900 m above MSL. These soils are extensively used for brick making.

3. ***Kattappana*** **series**

   They occur on steeply to very steeply sloping hill slopes of the high range region, at an elevation 600-1200 m MSL. They are very deep well drained clay soils with a dark colored clay loam surface horizon followed by yellowish red and red clay subsoil.

4. ***Pampadumpara*** **series**

   They occur on steeply to very steeply sloping hill slopes and hilltops of the high ranges at an elevation of 600-1200 m from MSL. They are very deep, well drained, clayey soils with a dark colored silky clay loam to clay loam, surface horizon, followed by red clayey subsoil fine quartz gravels of about 15-20 per cent is present below 60-70 cm.

3.4.5 Land capability classes

Five land capability classes have been identified in the watershed. They are III, IV,VI,VII and VIII. Distribution of area under the various land capability classes showed that 44 ha come under class III e category (4.37 per cent of the total area), III w includes 27 ha (2.68 per cent of the total area) and under class III there is a total area of 71 ha (7.05 per cent). Class IVe occupies 178 has IVe, 337 ha comes under class IV c, and 22 ha under class IV w. An area of 242 ha is under class VI es. It forms 24.04 per cent of the total area. About 120 ha is under class VII es (11.92 per cent of the total area). Water spread area is 37 ha (3.67 per cent).

3.4.6.Drainage and slope

Uppukandam Watershed is mainly drained by the stream *Uppukandam*. To this drainage, another stream originating from *Thulasippara* joins at *Parayankavala*. Near this point, tributaries from *Kochuthovala* and *Mulakaramedu* also join with *Uppukandam*. Together they flow to the *Erattayär* reservoir in the northern direction. *Uppukandam thodu* has its origin at *Anakuthimala* and *Pooresmount*. Many parallel streams from Chakakanam, *Poorsmount, Anakuthy and Parakkal* drains to the main *Uppukandam thodu*.

The watershed is situated in the very steeply sloping hilly terrain with isolated mounds and narrow valleys at an elevation range of 740m to 1116m above MSL. The ridge slopes are very steeply sloping and the valleys are moderately sloping. The slope wise distribution of the area is presented in Table 3.13.

Table 3.13. Slope wise distribution of area

Sl.No	Particulars	Area	Percentage to total area
1	Below 8 per cent slope	111 ha	11.02
2	Above 8 per cent slope	896	88.98

Around 89 per cent of the watershed has a slope of more than 8 per cent. Soil erosion and associated rapid depletion of nutrients from surface soil is the main problem, which affect the area. Absence of scientific crop management and water management has caused poor infiltration and poor production.

3.5. ELANAD WATERSHED

Elanad watershed is located between 76°21' and 76°25' east longitude and 10°35' and 10°38' north latitude. The watershed is comprised of a geographical area of 2140 ha. Its area spreads in the *Vennur* and *Elanadu* villages. The effective project area of the watershed is 1360 ha, of which the area under arable land is 1210 ha. The area under non arable land is 150 ha, while 780 ha of land is under forest (Table 3.14). The watershed spreads over in the midlands and mid uplands. They have an undulating to hilly topography with subnormal to excessive relief. The area is drained mainly by the *Cheppathodu* and finally drains into the *Mangalam* river.

Table 3.14. Physiographic features of Elanad watershed

Sl.No	Particulars	Features
1	District	Thrissur
2	Taluk	Thalappilly
3	Panchayath	Pazhayannur
4	Villages	Vennur and Elanadu
5	Latitude and longitude	north latitude at 10 ^{0} 35' and 10 ^{0} 38' and east longitude 76 ^{0} 21' and 76 ^{0} 25'
6	Total geographical area of watershed	2140 ha
7	Effective Project area	1360 ha
8	Area under arable land	1210ha
9	Area under non arable land	150 ha
10	Annual rainfall	2806 mm
11	Minimum temperature	23.1^0 C
12	Maximum temperature	32.5^0 C

3.5.1. Agroclimatic characteristicsm

Warm humid tropical climate prevails in the area with typical monsoon showers and dry spells. The area gets two monsoon showers, first during June to September and second during October to November with an average rainfall of 2806 mm. The dry spell usually extends over 4-5 months. During this period the area is under severe drought. The mean minimum temperature is 23.1^0 C and the mean maximum temperature is 32.5^0 C. The temperature class regime of the watershed is *hyperthermic* and the moisture regime is *ustic*.

3.5.2. Family size

There are 2194 families residing near the watershed area and the number of female members (4240) is greater than male members (4158) (Table 3.15).

Table 3.15. Family size

Sl.No	Particulars	Number
1	No. of families	2194
2	Male	4158 (49.51)
3	Female	4240 (50.49)
	Total	**8398 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

3.5.3. Cropping pattern

An area of 1360 ha is under intensive cultivation. Another area of 58 ha comes under the wetlands. Wetlands are generally cultivated under paddy, vegetables and pulses are also raised but in certain areas. Vegetables occupy an area of 30 ha with a productivity of 10 metric tonnes per ha. Pulses are raised in area of 10 ha and the productivity is 10 t /ha. Steep area and moderately steep areas are used for rubber cultivation. Moderately sloping areas are used for coconut cultivation. Coconut plantations are generally intercropped with arecanut and banana.

Most of the households reared poultry. It represented 79.65 per cent of the total livestock population. About 12 per cent of the total livestock population was cattle while 7 per cent of the total livestock population were goats.

3.5.4. Soils

The major soils identified in the area are presented in Table 3.16. They are the *Koottala, Kozhukully* and *Maraickal* series.

The *Koottala* series represent well-drained soils with moderately low to moderate permeability, very deep, dark brown to very dark-grayish brown sandy clay loam to loamy soils. These soils are found to occur on the hill slopes and foothill areas with 10-20 per cent slope on the eastern part of *Trichur* district. The soils are medium in fertility status and responds well to manurial application and management practices.

Table 3.16. Soil Series of the watershed

Sl.No	Physiographic	Soil series	Area (ha)
1	Mid land	Koottala	890.5
2	Mid-up land	Kozhukully	411.5
3	Low land	Maraickal	58
		Total	**1360**

The *Kozhukkully* series comprise of deep to very deep, excessively drained, dark brown to dark grayish –brown medium acid soils. These soils are generally found to occur on moderately steep to steeply sloping hillocks with a slope gradient of 20-50 per cent. The area is mostly under rubber plantation.

The *Maraickal* series comprise of very deep to moderately well drained soils. The water holding capacity of these soils is high. The productive potential of the soil is medium. The soils are somewhat fertile and cultivated under paddy, banana, vegetables, tubers etc.

3.6. PULIKALTHODE WATERSHED

The watershed is located in the northeastern part of *Ottapalam taluk*. The area spreads in *Vellinezhi* and *Sreekrishnapuram panchayaths* . It is located between north latitude at 10°48'00" and 10° 51' 30"and east longitude 76° 21'00" and 76°27'00". The watershed is comprised with in a geographical area of 950 ha. The effective projects area of the watershed is 878 ha of which the area under arable land is 793 ha and the area under non arable land is 85 ha. (Table 3.17)

Table 3.17. Physiographic features of Pulikkalthodu watershed

Sl.No	Particulars	Features
1	District	Palakkad
2	Taluk	Ottapalam
3	Panchayath	Vellinezhi and Sreekrishnapuram
4	Latitude and longitude	north latitude at 10°48'00" and 10° 51' 30"and east longitude 76° 21'00" and 76°27'00"
5	Total geographical area of watershed	950ha
6	Effective Project area	878ha
7	Area under arable land	793ha
8	Area under non arable land	85ha

3.6.1. Agroclimatic characteristics of Pulikkalthodu watershed

The watershed is bound by *Ponthalangadan mala* in the northern side, *S.K.Puram-Valampilimangalam* road in the eastern side, *Thiruvazhiyode kunnu, Kulakkad kunnu* in the southern side and the *Vellinezhi* ward –II in the western side. The main drainage is through *Thoothapuzha*, a tributary of *Bharathapuzha*, to which the *Pulikkathodu* joins at *Kuttanassery*. The *Malampallayil thodu* at T.N.Puram, and *Mannathil thodu* at S.K.Puram are the streams and streamlets supplying to *Pulikkathodu* which is the main stream.

3.6.2. Cropping pattern

The major crops grown were rice and coconut. However, rubber is now emerging as a potential cash crop in the area. Mounting cost of inputs, declining relative profitability, and labour problems are compelling the farmers to shift from rice cultivation.

3.7. CHARAL WATERSHED

Charal watershed of *Iritty* block in *Kannur* district consists of only one *panchayath* viz., *Ayyankunnu*.

3.7.1. Physiographic features

Charal watershed lies between 12° 2′ and 12° 4′ north latitude and 75° 47′ and 75° 49′ east longitude at an elevation from 80 to 1000m above MSL. *Moonnamkadavu* watershed and *Modayerinhi* watershed selected under NWDPRA during the Ninth plan period lies adjacent to *Charal* watershed. The watershed is bounded by *Ayyankunnu panchayath* on the north and *Charal puzha* on the west, *Moonnamkadavu* and *Modayerinhi* watershed on the eastern and southern side of the watershed. About 80 per cent of the watershed is very gently to moderately sloping. The physiographic features of the watershed are depicted in Table 3.18.

Table 3.18. Physiographic features of *Charal* watershed

Sl.No	Particulars	Features
1	District	Kannur
2	Block	Iritty
3	Panchayath	Ayyankunnu
4	Latitude and longitude	north latitude at 12° 2′ and 12° 4′ and east longitude 75° 47′ and 75° 49′
5	Effective Project area	714 ha
6	Area under arable land	603 ha
7	Area under non arable land	111 ha
8	Annual rainfall	3320 mm

3.7.2. Agroclimatic characteristics

The watershed spreads over an area of 726 ha in *Ayyankunnu panchayath* ward No.2 and parts of ward No.3. Roads, streams, and buildings cover an area of 14 ha. An area of 111 ha near *Ayyankunnu* hills is classified under non arable lands. The arable land of the watershed is about 603 ha. The effective area of the watershed is about 714 ha only.

The climate in the area is warm, humid tropical climate with mean annual rainfall of 3320 mm. Major portion of rainfall is obtained from the South West monsoon. Summer starts from January, and extends upto May with a high day temperature of 36.5 ^{0} C, which enhances evapo-transpiration resulting in drought

like situation. The fluctuation in rain affects the surface as well as the ground water resources of the watershed. Small streams may get dried up during summer reducing the volume of water in the mainstream.

3.8. POTHANKANDAM WATERSHED

The watershed is located in *Peringome Vayakkara panchayath* of *Payyannur* block of *Taliparamba taluk* in *Kannur* district. It lies between 12° 13' to 12° 16' north latitude and 75° 17' and 75° 20' east longitude at an elevation of 20 m above MSL. The physiographic details of the watershed are presented in Table 3.19.

Table 3.19. Physiographic features of *Pothankandam* watershed

Sl.No	Particulars	Features
1	District	Kannur
2	Taluk	Taliparamba
3	Panchayath	Peringome, Vayakkara
4 east	Latitude and longitude	north latitude at 12° 13' to 12° 16' and longitude 75° 17' and 75° 20'
5	Total geographical area of watershed	1078 ha
6	Effective Project area	1054 ha
7	Area under arable land	1046ha
8	Area under non arable land	8ha
9	Annual rainfall	3320 mm
10	Elevation	20 m above MSL

The *Pothamkandam* watershed is surrounded at north by *Kutteni* watershed and, east by *Kutteni* and *Perumba* watersheds, west by the *Kasaragode* district. The watershed spreads over an area of 1078 ha. Roads, streams, buildings etc covers an area of 8 ha (non arable area). The physiography of the watershed is undulating and the relief is subnormal. The drainage pattern is *dendritic*. The length of the drainage line is approximately 14 kms.

3.8.2. Agroclimatic characteristics

The watershed experiences a warm humid tropical climate with mean annual rainfall of 3320 mm. Major portion of rainfall is obtained from the South West monsoon. Rain is the major source of water. The physiography of the watershed enhances the loss of rainwater as runoff. Ground water is the major source of drinking water. People depend on the stream water for drinking and irrigation especially on the lower foothills. *Charalpuzha* is

the perennial water resource in the watershed. The arable land of the watershed is only 1046 ha. The effective project area of the watershed is 1054 ha.

*3.8.3.*Family size

The total population of the watershed is 3186 of which number of male population is 1569 and female population is 1617. The total number of families in the watershed area is 961. (Table 3.20).

Table 3.20.Family size and composition

Sl.No	Particulars	Number
1	No. of families	961
2	Male	1569 (49.25)
3	Female	1617 (50.75)
	Total	**3186** **100.00)**

(Figures in parentheses indicate percentage to the respective totals)

*3.8.3.*Land holding

The watershed area is constituted by landless to small farmers. The land holding pattern of the water shed depicted in Table 3.20. It revealed that 74.69 per cent of the farmers were marginal farmers and nearly 24 per cent were small farmers. The fragmentation of holdings into small pieces affect the agricultural productivity in the area.

Table 3.20. Pattern of land holding

Sl.No	Size	Number
1	Marginal (0-1 ha)	717 (79.82)
2	Small (1-2 ha)	231 (19.19)
4	Large (above 5 ha)	0 (0)
5	Landless	12 (1.00)
	Total	**1204** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

3.8.4. Cropping pattern

Agriculture forms the main source of income of the watershed community. Cash crops were the main crop of the watershed of which coconut (23.08 per cent) and arecanut (21.15 per cent) occupy the major area (Table 3.21). Pepper occupied nearly 21 per cent of the total area while 14 per cent was cultivated under rubber.

Table 3.21. Cropping pattern

Sl.No	Crops	Area (ha)
1	Cashew	145 (18.59)
2	Rubber	110 (14.10)
3	Coconut	180 (23.08)
4	Pepper	160 (20.51)
5	Arecanut	165 (21.15)
6	Fruit trees	20 (2.56)
	Total	**780 (100)**

(Figures in parentheses indicate percentage to the respective totals)

Most of the households reared poultry. It represented nearly 85 per cent of the total livestock population. Cows constituted only 15 per cent of the total livestock population in the water shed area.

3.8.5. Soils

Seven soil series have been identified in the water shed area. They are the *Panamkutty* soils, *Arathil* series, *Nadapuram* series, *Edanad* series, *Piathara* series, *Pudukai* series and the *Koipra* series.

The *Panamkutty* soils are very deep, imperfectly to moderately drained occurring on gently sloping lands on the bank of the streams. These soils are developed under warm humid tropical climate on alluvial sediments. These are subject to frequent flooding. Care should be taken to provide adequate drainage facilities.

The *Arathil* series is acidic, deep to very deep, excessively drained moderately permeable soils occurring on strongly sloping moderately steep sloping lands at an elevation of 20 M above MSL. As these soils are excessively drained, moisture stress is experienced during summer months. These soils are medium in nitrogen, high in phosphorous and medium in potash.

The *Nadapuram* series are very deep, imperfectly drained sols found in the valleys of midland region susceptible to submerged condition during monsoon. The soil is acidic in reaction. The nutrient status is poor. Imperfect drainage and submerged condition during monsoon limit the soil to put paddy as the main crop. Banana, pulses, vegetables and tapioca are other suitable crops with proper irrigation.

The *Edanad* series are very deep (above 90 cms), acidic, excessively drained with moderately rapid permeability. They occur on the foot slopes of low hills and in the concave depression foothills having a slope gradient of 1-5% (very gently to gently sloping) in the mid land region at an elevation of 20-60 cm above the MSL. These are low to medium in fertility status.

The *Piathara* series are moderately to slowly permeable, deep to very deep, excessively drained, acidic on flat hill tops of mid land region at an elevation from 40M above MSL.

The *Pudukai* series are very deep to deep reddish brown, gravelly loam to gravelly clay loam. These soils are moderately well drained with moderate permeability. These soils are acidic in reaction and the nutrient status is medium. The crops cultivated are coconut, arecanut, banana etc.

The *Koipra* series have reddish brown to yellowish red, gravelly silty loam to gravelly silty clay. Laterite stone boulders and weathered gneissic stones are noticed in the horizon. These soils are occurring on strongly sloping to steep sloping lands of mid upland region having laterite and gneissic rock out crops.

The soils of *Pothankandam* watershed has been classified into five classes viz., class 11,111,1V, V1 and V111. These are again classified according to their potentialities and limitations for sustained crop production.

It is against this broad background that the watershed development projects envisaged to implement the watershed components, and to initiate efforts to activate a watershed community to sustain the efforts.

□

CHAPTER 4
IMPACT EVALUATION

Soil, water and vegetation are the three most important natural resources for the existence of human beings and animals. It is needed in all aspects of life and health, for producing food, industrial activities, energy generation and maintenance of environment, for subsistence of life and development. Watershed management is the process of formulating and carrying out a course of action that seeks to harness the potential of natural, agricultural and human resources of the watershed area. The development of a watershed as a whole requires knowledge of resources in the area, and their interrelationships. Hence, any effort at watershed evaluation shall begin with the identification of biophysical and socioeconomic potential and limitations on a location-specific manner.

4.1. PALLICHAL WATERSHED

4.1.1. Family size

The distribution of sample farmers on the basis of family size is given in Table 4.1. Ninety six per cent farmers in the beneficiary as well as non-beneficiary category possessed a family size of less than 5 members, and rest of sample farmers had a family size between 6-7 members.

Table 4.1. Family size of the sample farmers in *Pallichal* watershed

Sl.No.	Family size	Beneficiary	Non-beneficiary
1	1-5	48 (96)	24 (96)
2	6-7	2 (4)	1 (4)
3	Above 7	0 (0)	0 (0)
	Total	**50** **(100)**	**25** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

4.1.2. Age

The classification of respondents on the basis of age is presented in Table 4.2. It showed that the maximum number of farmers belonged to age group between 35-55 years and least proportion belongs to age group lesser than 35 years in both the beneficiary and non beneficiary samples. Among the beneficiaries, 70 per cent of respondents belonged to

the age group between 35-55 years, while it was 48 per cent in the case of non-beneficiaries. Older farmers (ie. farmers in the age group of more than 55 years) accounted for 30 and 44 percentages respectively in the case of beneficiary and non-beneficiary group.

4.1.3. Educational status

The classification of respondent's family based on educational level is given in Table 4.3. Nearly 91 per cent had formal schooling while for non-beneficiary it is 75 per cent. It is

Table 4.2. Age group of the sample farmers in *Pallichal* watershed

Sl.No.	Age group (Years)	Beneficiary	Non-beneficiary
1	Less than 35	0 (0)	2 (8)
2	35-55	35 (70)	12 (48)
3	More than 55	15 (30)	11 (44)
	Total	**50** **(100)**	**25** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

worth mentioning that illiterate farmers accounted for 4 per cent and 5 per cent of beneficiaries and non-beneficiaries respectively. Three percent of beneficiary farmers were post-graduates while farmers with post graduation were not encountered among non-beneficiaries. There was no visible impact of the project on the educational level of the beneficiary farmers.

Table 4.3. Educational level of the sample farmers in *Pallichal* watershed

Sl.No.	Educational level	Beneficiary	Non-beneficiary
1	Illiterate	7 (4)	5 (4.90)
2	Formal schooling	180 (91)	77 (75.50)
3	Graduation	4 (2)	20 (19.60)
4	Post graduation	6 (3)	0 (0)
	Total	**197** **(100)**	**102** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

4.1.4. Family income

The majority of the beneficiary as well as non beneficiary farmers belonged to the income group of Rs.50,000- 1,00,000 (Table 4.4). Hardly 10 per cent of the beneficiary farmers belonged to more than one lakh income group, while 8 per cent of non beneficiary farmers belonged to this higher income group.

4.1.5 Land use pattern

The land use pattern of the respondent farmers are presented in Table 4.5.The watershed development programme could bring about no noticeable changes in the land use

Table 4.4. Annual family income of the sample farmers in *Pallichal* watershed

Sl.No.	Family income per annum	Respondents	
	(Rs)	Beneficiary	Non-beneficiary
1	Less 50, 000	10 (20.00)	8 (32.00)
2	50, 000-100,000	35 (70.00)	15 (60.00)
3	Greater than 100, 000	5 (10.00)	2 (8.00)
	Total	**50** **(100.00)**	**25** **(100.00)**

(Figures in parentheses indicate percentage to the respective totals)

pattern for agriculture .There was nearly 1.73 per cent increase in the agricultural area, which was additional area brought under fodder as well as agro forestry cultivation.

Table 4.5. Land use pattern of the sample farmers in *Pallichal* watershed (ha)

Sl.No.	Land use	Beneficiary		Non-beneficiary
		Before WDP	After WDP	
1	Agriculture	2.31	2.35	2.54
2	Non agriculture	0.19	0.15	0.16
Total		**2.50**	**2.50**	**2.70**

4.1.6. Cropping pattern

The cropping pattern of the of the sample farmers in *Pallichal* watershed is presented in Table 4.6. It showed that coconut was the predominant crop in the area, which occupied 83.89 per cent of total cropped area of the beneficiary farmers. This was followed by banana and pepper, which accounted for 13.56 per cent of the cropped area. Coconut and rubber accounted for 78.04 and 9.8 per cent of the cropped of the non beneficiary farmers. Thus, pernnial crops dominated the cropping pattern, and the share of annual crops like vegetables was very low.

4.1.7. Cropping Intensity of the farmers

The cropping intensity of the respondent farmers are worked out and presented in Table 4.7. It can be noted that the cropping intensity was low, and there was no significant difference in the cropping intensity of beneficiary and non beneficiary farmers. The low cropping intensity is on account of the domination of perennial crops in the cropping pattern, which provides less flexibility for area that can be sown more than once.

Table 4. 6. Cropping pattern of the sample farmers in *Pallichal* watershed

Sl.No.	Crops	Beneficiary	Non-beneficiary
1	Coconut	1.98 (83.89)	1.99 (78.04)
2	Arecanut	0 (0)	0.003 (0.12
3	Rubber	0.02 (0.85)	0.25 (9.80)
4	Banana	0.16 (6.78)	0.24 (9.41)
5	Pepper	0.16 (6.78)	0.008 (0.30)
6	Vegetables	0.02 (0.85)	0.01 (0.38
7	Others	0.02 (0.85)	0.05 (1.95)
	Total	**2.36** **(100.00)**	**2.55** **(100.00)**

(Figures in parentheses indicate percentage to the respective totals)

Table 4.7. Cropping intensity of the sample farmers in *Pallichal* watershed

Sl.No.	Category	Gross sown area (ha)	Net sown area (ha)	Cropping intensity (%)
1	Beneficiary	2.36	2.14	110.28
2	Non-beneficiary	2.55	2.25	113.33

4.1.8. Labour use pattern

The labour use pattern showed an increase in labour use in case of beneficiary farmers after the implementation of the watershed development project as shown in Table 4.8. The increase in per hectare labour use varied from nearly 16 to 18 percent, with banana and coconut registering more increase in labour use.

4.1.9. Productivity of major crops

The productivity of major crops in the project area before and after investment and in control group is presented Table 4.9.

It can be noted that that the productivity of coconut increased from 24 nuts per palm to 32 nuts per palm in the watershed area, representing an increase by 33 per cent. The productivity

Table 4.8. Labour use pattern of the sample farmers in *Pallichal* watershed (labour days per ha)

		Beneficiary				
Sl.No.	Crops	Before WDP	After WDP	change over time	% Non beneficiary	% change over control
1	Coconut	77	90	16.86	89	15.58
2	Banana	120	141	17.50	139	15.83
3	Pepper	76	88	15.79	87	14.47
4	Rubber	147	169	14.97	166	12.93
Mean		**105**	**122**	**16.19**	**120**	**14.52**

Table 4.9 Productivity of major crops in *Pallichal* watershed

		Beneficiary				
Sl.No.	Crops	Before WDP	After WDP	change over time	% Non beneficiary	% change over control
1	Coconut (nuts /palm)	24	32	33.33	28	16.67
2	Banana (kg/ha)	3126	3886	29.26	3523	18.21
3	Pepper (kg/ha)	186	236	24.31	219	12.70
4	Rubber (kg/ha)	950	1228	26.88	1123	17.74

of pepper and banana increased were from 186 kg/ha to 236 kg/ ha and from 3126 kg/ha to 3886 kg/ha respectively. The productivity of rubber increased from 950 kg per ha to 1228 kg per ha, representing an increase by nearly 27 per cent (Fig. 4.1).

4.1.10. Crop wise farm expenses

The crop wise farm cultivation expenses in the watershed area are presented in tables from 4.10, 4.11, 4.12 and 4.13. It showed that farm cultivation expenses for coconut, pepper, rubber and banana underwent substantial change in the post project period. On an average, there was an increase of 9.52 per cent in coconut cultivation expenses in coconut at the 1998-99 constant prices. This was accounted mainly by the increased use and therefore higher expenditure on manures and fertilizers.

Table 4.10. Input wise farm expenses for coconut crop in *Pallichal* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP (at 1998-99 prices)	After WDP (at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	8442	9856	8683	9764	8602
2	Seeds	1925	2655	2339	1852	1632
3	Manures	1080	1546	1362	986	869
4	Fertilizers	2595	3400	2995	3174	2796
5	PP chemicals	0	0	0	0	0
	Total	**14, 042**	**17, 457**	**15, 379**	**15, 776**	**13, 899**

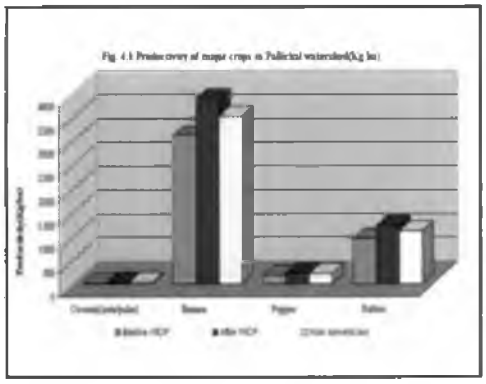
Table 4.11. Input wise farm expenses for banana crop in *Pallichal* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	13,232	15,467	13,626	15,264	13,448
2	Seeds	1652	2100	1850	2225	1960
3	Manures	4563	5648	4976	3654	3219
4	Fertilizers	3996	4781	4212	4521	3983
5	PP chemicals	1569	1969	1735	1854	1633
	Total	25, 012	29, 965	26, 399	27, 518	24, 243

In the case of rubber, the cost increase was from Rs. 24220 to Rs 25692 (at 1998-99 constant prices). The expenses incurred for pepper increased from Rs. 14302 to Rs. 15722. The increased cost of cultivation in banana, pepper and rubber could also be attributed to the increased use of manures and fertilizers the post project period. The inference is clear. The increased moisture availability facilitated increased use of manure and fertilizer application.

Table 4.12. Input wise farm expenses for pepper crop in *Pallichal* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	8385	9732	8574	9547	8411
2	Seeds	1632	2075	1828	1658	1461
3	Manures	2320	3365	2965	3341	2943
4	Fertilizers	1015	14547	1363	1145	1009
5	PP chemicals	950	1126	992	1012	892
	Total	14,302	17,845	15,722	16,703	14,716



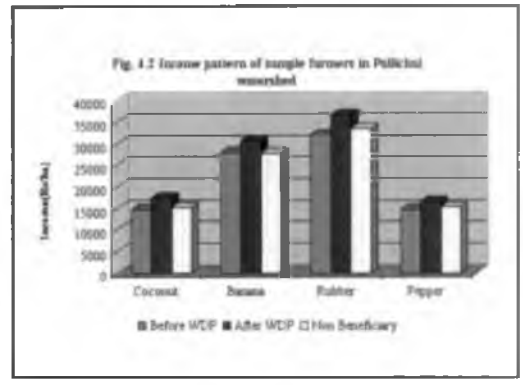


Fig. 4.2 Income pattern of sample farmers in Pallichal watershed
40000
35000
30000
25000
20000
15000
10000
5000
0
Coconut
Banana
Rubber
Pepper
Before WDP
After WDP
Non Beneficiary

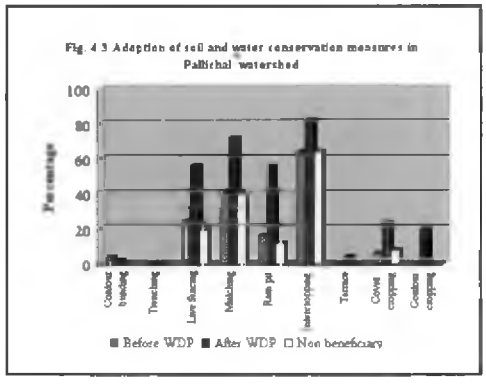


Fig. 4.3 Adoption of soil and water conservation measures in Pallichal watershed
Percentage
100
80
60
40
20
0
Contour trenching
Terracing
Live fencing
Mulching
Rain pit
Intercropping
Terrace
Cover cropping
Gunnbow cropping
Before WDP
After WDP
Non beneficiary

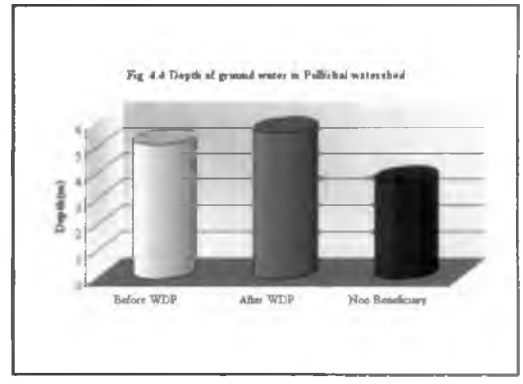
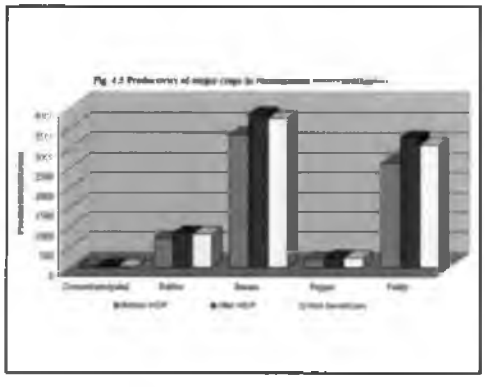


Fig. 4.4 Depth of ground water in Pallichal watershed
Depth(m)
Before WDP
After WDP
Non Beneficiary



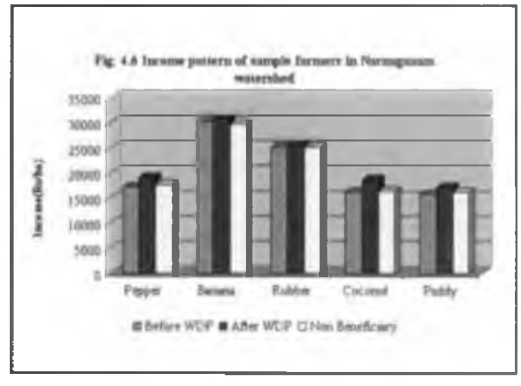


Fig. 4.6 Income pattern of sample farmers in Neyyoorum watershed
35000
30000
25000
20000
15000
10000
5000
0
Pepper
Banana
Rubber
Coconut
Paddy
Before WDP
After WDP
Non Beneficiary

Table 4.13. Input wise farm expenses for rubber crop in *Pallichal* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	16,120	18,547	16,340	18,241	16,070
2	Seeds	2650	3850	3392	2680	2361
3	Manures	2550	3150	2775	2982	2627
4	Fertilizers	2650	3250	2863	3598	3170
5	PP chemicals	250	365	322	346	305
	Total	24, 220	29, 162	25, 6952	27, 847	24, 533

4.1.11. Income pattern

The farm income of the farmers in the project area and non project area as depicted in Table 4.14. It revealed that the income per hectare from coconut for the beneficiary increased from Rs.14352 before WDP to Rs. 16492 (at 1998-99 constant prices) in the project area while it was Rs. 14293 for the non project area. A crop wise analysis of the farm income per hectare revealed that rubber, pepper and arecanut showed substantial increase in income for the beneficiary after implementation of the programme in nominal as well as real terms(Fig. 4.2). The income increased by nearly 13 per cent in real terms after the project implementation.

Table 4.14. Income pattern of the sample farmers in *Pallichal* watershed (Rs/ha)

Sl.No.	Input	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Coconut	14976	19968	17591	17.46	17472	15392
2	Banana	28134	34974	30812	9.52	30707	27933
3	Rubber	32300	41752	36783	13.88	38182	33638
4	Pepper	14880	18880	16633	11.78	17520	15435
	Mean	**22, 573**	**28, 894**	**25, 455**	**12. 77**	**25, 970**	**23, 099**

4.1.12. Livestock Status

Watershed Development Programmes have brought out certain changes in livestock production systems (Table 4. 15). The average number of cow per farm has increased from 0.3 to.0.5, where as in the case of goat the increase is from 0.04 to 0.08. In the case of poultry, there is no change is observed.

Table 4.15. Livestock status of the sample farmers in *Pallichal* watershed (No. / farm)

Sl.No.	Category	Beneficiary		Non-beneficiary
		Before WDP	After WDP	
1	Cow	0.3	0.5	0.4
2	Goat	0.04	0.08	0
3	Pig	0	0	0
4	Poultry	0.5	0.5	0

It is evident from Table 4.16 that the expenses incurred for livestock rearing came down in real terms in the post project period. This was evident in most inputs. The reduction in dry fodder expenses is related with the impetus provided for on-farm fodder cultivation. Cultivation of fodder crops in the interspaces of coconut, and on earthen bunds increased the green fodder availability(Plate1). The milk yield increased, and income from milk increased by nearly 14 per cent during the project period.

Table 4.16. Cost of livestock production in *Pallichal* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiary			Non beneficiary	
		Before WDP (1998-99)	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current prices (2003-04)	At constant prices (1998-99)
1	Concentrate	1616	1716	1511	1971	1736
2	Dry fodder	1123	1241	1093	1022	900
3	Labour charge	985	1125	991	1175	1035
4	Miscellaneous expenses	1180	1187	1046	1134	999
	Total	**4904**	**5269**	**4641**	**5302**	**4670**

4.1.13. Soil and water conservation

The watershed development programmes are addressed mainly to areas suffering from soil degradation and moisture stress. Soil erosion is a general problem in the watershed. Major area of the arable land shows medium rate of soil erosion. High rate of soil erosion is noticed at certain pockets with specific topographic and drainage characteristics. Some

Table 4. 17. Livestock Income in *Pallichal* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiary			Non beneficiary	
		Before WDP (1998-99)	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current prices (2003-04)	At constant prices (1998-99)
1	Milk	8562	11,064	9747	10,082	8882
2	Dung	1020	1154	1017	940	828
	Total	**9582**	**12,218**	**10,764**	**11,022**	**9710**

areas at the hill tops and valleys are featured with low erosion. The developments works undertaken falls in three categories viz. development of land resources through soil conservation works, development of water resources through in-situ conservation and harvesting and also proper utilization of irrigation sources and agro-forestry, cultivation of fodder grass/ crops etc.

There was a general improvement in the adoption of scientific knowledge and soil conservation practices in the watershed area (Table 4.18 and Plates 2, 3 and 4). Among the soil conservation practices, intercropping (82 %) and mulching (72 %) found widespread adoption. Twenty per cent farmers adopted contour cropping, while 24 per cent farmers adopted cover cropping. A comparison of soil and water conservation practices before WDP and after WDP showed that there is considerable adoption of rain pit construction, for which the number of adopters has increased from 8 to 28 (Fig. 4.3).

4.1.14. Organic matter content of the soil

The organic matter content of the soil was analyzed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 0.1 to.1.1 percent in the beneficiary sample with a mean of 0.3. In the control plot, the range was from 0.6 to 1.0 per cent with a mean value of 0.7.The average content of organic matter in the soil was higher for the non beneficiaries. However, this difference cannot be attributed to the implementation of the watershed programme in any manner.

Table 4.18. Adoption of soil and water conservation measures in *Pallichal* watershed (no: of the respondents)

Sl.No.	Category	Beneficiary		Non beneficiary
		Before WDP	After WDP	
1	Contour bunding	2 (4)	1 (1.90)	0 (0)
2	Trenching	0 (0)	0 (0)	0 (0)
3	Live fencing	12 (24)	28 (56)	5 (20)
4	Mulching	20 (40)	36 (72)	10 (40)
5	Rain pit	8 (16)	28 (56)	3 (12)
6	Intercropping	32 (64)	41 (82)	16 (64)
7	Terrace	0 (0)	2 (4)	0 (0)
8	Cover cropping	3 (6)	12 (24)	2 (8)
9	Contour cropping	0 (0)	10 (20)	0 (0)

(Figures in parentheses indicate percentage to the respective totals)

4.1.15. Ground water status

A number of programmes had been proposed and implemented to harvest the rainwater to increase the water table, moisture content and vegetative cover. Table 4.19 shows the assistance given for the renovation of wells and ponds under this head. It can be noted that out of 50 beneficiary farmers selected, 49 owned wells and 8 had ponds in their households. Five of the beneficiary had availed the assistance for the renovation of well, while 2 of them had availed the assistance for the renovation of ponds. In the non-beneficiary group, 21 households owned wells, while none had had ponds.

The average depth of ground water, and its variation in the summer and rainy seasons is presented Table 4.20. It indicated that the average depth of groundwater was 5.18 m before WDP. It increased to 5.18 m in the post WDP period, registering an increase by 9.07 per cent. The average depth of ground water in the non beneficiary group was 3.75 m. It

Plate 1. Fodder cultivation in Pallichal

Plate 2. Terraced cultivation in Pallichal

Plate 3. Gyricidia fencing in Pallichal

Plate 4. Increased water harvesting in Pallichal

Plate 5. Less sedimentation due to treatment in Pallichal

Plate 6. Loose boulder check dam in Naranganam

revealed that the watershed programme has brought about a positive impact on the moisture regime with considerable rise in the ground water level of the beneficiary(Fig. 4.4 and Plate 5) . This could be due to ground water recharge on account of conservation measures.

4.1.16. Distribution of inputs for Beneficiary

The details of inputs distributed to the beneficiary farmers are given in Table 4.21. It can be seen a total of 1535 planting materials were distributed, of which 1345 were banana suckers, and 160 were cuttings. Krishi Bhavan was the leading source of planting materials. This is an insignificant number from the angle of green cover or agroforestry in a watershed area. Private agencies played a major role in the distribution of fertilizers. No PP chemicals and mechanical equipments were distributed to the farmers under the programme.

Table 4.19. Assistance for renovation of wells and ponds in *Pallichal* watershed (Number)

Sl.No.	Respondents	Well	Pond
1	Beneficiary	49 (5)	8 (2)
2	Non Beneficiary	21 (0)	0 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

Table 4.20. Depth of Ground water in *Pallichal* watershed (in meters)

Sl.No.	Beneficiary	Before WDP	After WDP	% increase
A	Lowest	2.86	3.20	11.89
B	Highest	7.5	8.1	8.00
C	Average	5.18	5.65	9.07
	Non Beneficiary			
A	Lowest	-	2.1	-
B	Highest	-	5.4	-
C	Average	-	3.75	-

4.1.17. Allocation and Utilization of watershed budget

According to the "Revised Guidelines", the development component like natural resource management, farm production system for land owning families, and livelihood support system for landless families shall receive the major allocation of the watershed budget (77.50 %) while the management components like administration cost, community

Table 4.21. Distribution of inputs for Beneficiary farmers in *Pallichal* watershed (number)

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	KAU	Total	KB	Private	KAU	Co-op	Total
Planting materials (number)	0	0	0	0	0	1045	450	250	0	1535
Fertilizer (Kg)	0	0	0	0	0	8	42	0	0	50
PP chemical (ml)	0	0	0	0	0	0	0	0	0	0
Mechanical equipment (number)	0	0	0	0	0	0	0	0	0	0

organization and training programme shall receive nearly 22.5 per cent of the total outlay as shown in Table 4.22. The actual allocation and utilization of *pallichal* watershed budget is presented in Table 4.23. It can be seen that the development component accounted for 82 per cent of the watershed budget. This was at the expense of the management component, which received nearly 18 per cent of the watershed budget only. Conservation measures such as husk trenching did not receive any allotment in spite of the fact that coconut dominated the cropping pattern. Similarly, compost pit construction as part of promoting organic farming system, and establishment of nurseries also did not receive any allotment.

Table 4.22. Norms for Allocation and Utilisation of watershed budget

Sl.No.	Components	Allocation of funds (%)
A	Management components	
I	Administration cost	10.00
ii	Community organisation	7.50
iii	Training programmes	5.00
	Sub total	***22.50***
B	Development component	
I	Natural resource management	50.00
ii	Farm production system for land owning families	20.00
iii	Livelihood support system for landless families	7.50
	Sub total	***77.50***
	Grand Total	**100.00**

Source : " Revised Guidelines" , pp.27-28

Table 4.23. Allocation and Utilisation of budget in *Pallichal* watershed

Sl.No	Components	Allocation of funds (Rs lakhs)	% to total
A	Management components	4.31	17.69
B	Development component		
I	Arable land		
	Conservation measures	9.24	37.93
	Production system	2.44	10.02
II	Non arable land		
	Conservation measures	2.25	9.24
	Production system	1.33	5.46
	Drainage line treatment	3.71	15.23
	Livestock management	1.08	4.43
	Sub total	***20.05***	***82.31***
	Grand Total	**24.36**	**100.00**

Under livestock management, renovation of cattleshed received Rs.0.76 lakhs, while fodder production received only Rs.0.32 lakhs.

4.1.18. Constraints in the watershed development programme

The constraints in the watershed development programme as perceived by the stakeholders are given in Table 4.24. They were ranked based on the scores assigned. We can observe that non-availability of irrigation water, untimely distribution of inputs and subsidy from Krishi Bhavan, lack of awareness about the beneficial aspects of the programme, insufficient credit availability and lack of technical guidance were the first five constraints indicated by the beneficiary farmers in the watershed area. It is an irony that in spite of increased water availability of water in the area, there was still shortage of irrigation water in the area. It indicated that people's participation in the project planning and implementation was low, and such problems can be overcome with participatory approach in planning and implementation. The stakeholders perceived political interference and inadequacy of sanctioned amount as constraints of lesser significance.

The following conclusions emerge from the above analyses:

- The programme resulted in enhanced water harvesting in the watershed area. There was moderate raise in water table, which in turn, helped to enhance crop productivity. On an average, the productivity of major crops recorded an increase of 24-33 percent, the highest being in coconut.
- The increased crop productivity translated into higher farm income in nominal as well as real terms. The average farm income increase to the tune of 12.97 per cent in real terms.

Table 4.24. Constraints in the watershed development programme in *Pallichal* watershed

Sl.No.	Constraint	Rank
1	Non-availability of irrigation water	1
2	Untimely availability of inputs and subsidy from Krishi Bhavan	2
3	Lack of awareness about the beneficial programme	3
4	Insufficient credit availability	4
5	Lack of technical guidance	5
6	Political interference	6
7	Lack of supervision and follow-up	7
8	Inadequacy of sanctioned amount	8
9	Others	9

- There has been an increase in employment generation on account of the increase in labour use in agriculture related activities during the post project period. The labour use in agriculture recorded an increase of nearly 17 percent, the highest being in banana cultivation.

- The training programme was effective, and there is high adoption of soil and water conservation practices such as rainwater pitting, contour cropping, live fencing etc. This resulted in farm asset creation among beneficiary farmers.

- However, the project could not make any perceptible impact on green cover and microclimate, cropping pattern, cropping intensity and soil fertility status.

- There were no efforts to have conservation measures in non-arable land. The success of watershed development crucially depends on the holistic approach, whereby arable and non arable land receives priority in treatments.

- There was increase in green fodder availability among beneficiary farmers.

- There were no increased efficiency in stream bank stabilization and better drainage facilities developed on account of the drainage canals. However, the banks of the drainage lines in the lower and middle reaches were badly affected by the flow. Breaches and collapses were seen at many locations of the drain banks, indicating the lower quality of civil works undertaken.

- There was increase in green fodder cultivation and availability. There was an increase in the livestock population during the post project period. The livestock income also recorded an increase in real terms during this period.

- There was no fund earmarked for the maintenance civil works beyond the project period. Once the government support and funding ceased, it could lead to the neglect of civil works and conservation efforts already made. This lead to serious questions on the sustainability of conservation measures adopted.

- The project failed to make any impact on women landless people and availability of firewood. A greater degree of inter-agency coordination between the Department of Agriculture, Department of Soil Conservation, Department of Animal Husbandry, Department of Dairying and Forest Department are required to achieve this objective. For many reasons, such coordination among participatory agencies was not effective.

- Finally, the "1994 Guidelines" eloquently advocates people's participation in the success of the watershed development programme. However, people's participation in the project planning and implementation was low in the project under reference. That is why in spite of making impact on ground water status and improved water availability, non-availability of water continued to be the greatest constraint in the project area.

4.2. NARANGANAM WATERSHED

4.2.1. Family size

The distribution of sample farmers on the basis of family size is given in Table 4.25.

Table 4.25. Family size of the sample farmers in *Naranganam* watershed

Sl.No.	Family size	Beneficiaries	Non-beneficiaries
1	1-5	46 (92.00)	24 (96.00)
2	6-7	4 (8.00)	1 (4.00)
3	Above 7	0 (0.00)	0 (0.00)
Total		**50** **(100.00)**	**25** **(100.00)**

(Figures in parentheses indicate percentage to the respective totals)

Ninety two per cent farmers in the beneficiary farmers and ninety six percent of non beneficiary category possessed a family size between 1-5 members and rest of sample farmers had a family size of 6-7 members.

4.2.2.Age

The classification of respondents on the basis of age shown in Table 4.26. It the maximum number of farmers belonged to age group 35-55 years for both category of farmers.

Table 4.26. Age group of the sample farmers in *Naranganam* watershed

Sl.No	Age group (Years)	Beneficiaries	Non-beneficiaries
1	Less than 35	0	3 (12.00)
2	35-55	25 (50.00)	12 (48.00)
3	More than 55	25 (50.00)	10 (40.00)
	Total	**50 (100.00)**	**25 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

Composition of the aged group also did not differ significantly among the beneficiary and non beneficiary farmers. It formed 50 and 40 per cent respectively of the beneficiary and non beneficiary farmers.

4.2.3. Educational status

The classification of respondent's family based on educational level is presented in Table 4.27.

Table 4.27. Educational level of the sample farmers in *Naranganam* watershed

Sl.No	Educational level	Beneficiaries	Non-beneficiaries
1	Illiterate	4 (1.8.)	3 (3.3.)
2	Formal schooling	159 (73.3)	72 (79.1)
3	Graduation	15 (6.9.)	16 (17.6)
4	Post graduation	39 (18.0.)	0 (0.00)
	Total	**217 (100.00)**	**91 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

It can be noted that majority of the farmers in both groups had formal schooling. Nearly seven per cent of the beneficiaries were postgraduates while none of the non-beneficiaries were postgraduates. However, it is inferred that the programme is not instrumental in making any impact on the educational status of the farm households in the area.

4.2.4. Family income

An analysis of Table 4.28 indicated that nearly fifty per cent of farmers in the beneficiary group had an annual family income of one lakh rupees, while it was only 12 per cent in case of non beneficiaries. Majority of the non beneficiary farmers belonged to the income group of 50,000 to 1 lakh.

Table 4.28. Annual family income of the sample farmers in *Naranganam* watershed

Sl.No	Family income per annum (Rs)	Beneficiaries	Non-beneficiaries
1	< 50, 000	8 (16.00)	5 (20.00)
2	50,000-100,000	18 (36.00)	17 (68.00)
3	> 100, 000	24 (48.00)	3 (12.00)
	Total	**50 (100.00)**	**25 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

4.2.5. Land use pattern

The watershed development programme has brought only a small change in the pattern of land use for agriculture (Table 4.29). The area under agriculture increased slightly by 0.83 per cent.

Table 4.29. Land use pattern of the sample farmers in *Naranganam* watershed (ha)

Sl.No.	Land use	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Agriculture	2.40	2.42	1.10
2	Non agriculture	0.06	0.04	0.16
	Total	**2.46**	**2.46**	**1.26**

4.2.6. Cropping pattern of the sample farmers

The cropping pattern of sample farmers is given in Table 4.30. Coconut occupied 66 per cent of the cropped area of beneficiary farmers. Rubber was the next major crop cultivated,

accounting for 22 per cent of the cropped area. Crops like rice (4.54 per cent), tuber crops (1.6 per cent) occupied less area. Rubber was the major cash crop cultivated by the non beneficiary farmers (13.6 per cent). Coconut was grown under 7.2 per cent of the cropped area by the non beneficiary farmers. The farmers were growing an array of perennial trees like jack, mango, guava, teak, *anjili* etc. in the interspaces of coconut and in the boundaries. This resulted in a very high proportion of area under other crops.

4.2.7. Cropping Intensity

The cropping intensity of the respondent farmers were worked out and presented in Table 4.31. It can be noted that the cropping intensity was low, and there was no significant difference in

Table 4.30 Cropping pattern of the sample farmers in *Naranganam* watershed (ha)

Sl.No	Crops	Beneficiaries	Non beneficiaries
1	Coconut	1.60 (66.14)	0.08 (7.2)
2	Rubber	0.54 (22.32)	0.15 (13.6)
3	Banana	0.01 (0.41)	0.02 (1.8)
4	Pepper	0.01 (0.41)	0.04 (3.6)
5	Arecanut	0.01 (0.21)	0.02 (1.8)
6	Rice	0.11 (4.55)	0.11 (10.0)
7	Ginger	0.01 (0.21)	0.02 (1.8)
8	Tuber crops	0.04 (1.65)	0.07 (6.36)
9	Other crops	0.10 (4.13)	0.60 (54.54)
	Total	**2.42 (100.00)**	**1.10 (100.00)**

the cropping intensity of beneficiary and non beneficiary farmers. The low cropping intensity is on account of the domination of perennial crops in the cropping pattern, which provides less flexibility for area that can be sown more than once.

Table 4.31. Cropping intensity of the sample farmers in *Naranganam* watershed

Sl.No.	Category	Gross sown area (ha)	Net sown area (ha)	Cropping intensity (%)
1	Beneficiary	2.40	2.19	109.59
2	Non-beneficiary	1.10	0.97	113.40

4.2.8. Labour use pattern

The labour use pattern as shown in Table 4.32 showed an increase in labour use following the implementation of the project in case of beneficiaries. The increase in labour use per hectare was substantial for coconut (20.24 per cent), and pepper (15.63 per cent). The increase in labour use ranged from 12 to 14 per cent for paddy and banana.

4.2.9. Productivity of major crops

Productivity of all the major cultivated crops in the beneficiary farms recorded an

Table 4.32. Labour use pattern of the sample farmers in *Naranganam* watershed (labour days per ha)

		Beneficiary				
Sl.No.	Crops	Before WDP	After WDP	% change over time	Non beneficiary	% change over control
1	Pepper	96	111	15.63	110	0.91
2	Banana	158	181	14.56	178	1.69
3	Coconut	84	101	20.24	99	2.02
4	Rubber	148	169	14.19	154	9.74
5	Paddy	136	153	12.50	143	6.99
	Mean	**124.40**	**143.00**	**14.95**	**136.80**	**4.53**

increase in yield in the post project period. The increase yield in varied from 24 per cent paddy to 30 per cent increase in coconut(Fig. 4.5).

4.2.10. Crop wise farm expenses

The cost of cultivation of major crops in the watershed is estimated in nominal as well as in real terms using constant prices (Table 4.34,4.35, 4.36, 4.37 and 4.38). The

Table 4.33. Productivity of major crops in *Naranganam* watershed (Kg /ha)

		Beneficiary				
Sl.No.	Crops	Before WDP	After WDP	% change over time	Non beneficiary	% change over control
1	Coconut (nuts /palm)	26	34	30.77	30	13.33
2	Rubber	743	856	15.21	842	1.66
3	Banana	3346	3862	15.42	3750	2.99
4	Pepper	216	272	25.93	252	7.94
5	Paddy	2633	3265	24.00	3080	6.01

comparisons have been made in real terms. It showed that though the cost of cultivation of paddy increased in nominal terms during the project period, it recorded a decline in actual terms by 0.86 per cent. This was reflected by a fall in cultivation cost in all inputs used.

The cost of cultivation of coconut increased by 4.19 per cent. This was more on account of increased use of labour components than other material inputs used. The cost of cultivation of banana increased by 10.58 per cent. This was more on account of increased use of material inputs like manures and fertilizers than on account of increased use of labour. The cost of cultivation of black pepper did not show any marked increase during the project implementation. There was an increase in the use of material inputs like manures and fertilizers, but expenditure on labour use did not change much in relative terms. The expenditure on material inputs as well as labour input did not increase as far as rubber crop was concerned.

4.2.11. Income pattern

The farm income of the farmers in the project area and non project area are depicted in Table 4.39. It indicated that the farm income per hectare during the project implementation period increased by 6.40 per cent in real terms. The increase was less pronounced for rubber (1.50 %) and banana (1.68 %) . Farm income from pepper increased by 10.94 per cent, while it increased by 15.21 per cent for coconut. Paddy recorded a modest increase by 9.24 per cent(Fig. 4.6).

4.2.12. Livestock status

Watershed Development Programmes aims at bringing certain changes in livestock production systems using increased quantity of fodder, improvement of livestock

Table 4.34. Input wise farm expenses for Paddy crop in *Naranganam* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,320	11,810	10,405	10,920	9621
2	Seeds	3256	3623	3192	3585	3158
3	Manures	640	680	599	563	496
4	Fertilizers	358	345	304	330	291
5	PP chemicals	356	342	301	372	328
	Total	**14, 930**	**16, 800**	**14, 801**	**15, 770**	**13, 894**

management systems etc. The changing status of livestock in the beneficiary farms is shown in Table 4.40. The average number of cow per farm decreased from 1.3 per farm to one where as in the case of poultry, there is four-fold increase. The increase in the poultry population was due to increasing demand for chicken meat in the area. As far as the population

Table 4.35. Input wise farm expenses for coconut crop in *Naranganam* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	9225	11,060	9744	10,900	9603
2	Seeds	0	0	0	0	0
3	Manures	1020	1225	1079	764	673
4	Fertilizers	672	625	551	582	513
5	PP chemicals	0	0	0	0	0
	Total	**10, 917**	**12, 910**	**11, 374**	**12, 246**	**10, 789**

Table 4.36. Input wise farm expenses for banana crop in *Naranganam* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,550	12,180	10,731	12,050	10,616
2	Seeds	430	620	546	520	458
3	Manures	4100	5900	5198	5250	4623
4	Fertilizers	560	736	648	680	599
5	PP chemicals	460	773	681	550	485
	Total	**16, 100**	**20, 209**	**17, 804**	**19, 050**	**16, 781**

of goat was concerned, there was no change in the status. The cost of production of livestock declined in real terms during the project period (Table 4.41). The cost of concentrates as well as dry fodder declined during this period.

Table 4.37. Input wise farm expenses for Pepper crop in *Naranganam* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	17,410	19,920	17,550	19,610	17,276
2	Seeds	0	0	0	0	0
3	Manures	7650	8930	7867	8200	7224
4	Fertilizers	4010	4752	4187	5630	4960
5	PP chemicals	450	290	255	250	220
	Total	**29, 520**	**33, 892**	**29, 859**	**33, 690**	**29, 680**

Table 4.38. Input wise farm expenses for rubber crop in *Naränganam* watershed (Rs/ ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	16,320	18,547	16,340	18,342	16,159
2	Seeds	0	0	0	0	0
3	Manures	2725	3150	2775	2933	2584
4	Fertilizers	2750	3220	2837	3564	3140
5	PP chemicals	275	365	322	410	361
	Total	**22, 070**	**25, 282**	**22, 274**	**25, 249**	**22, 244**

It is evident from Table 4.42 that though the farmers earned profit through livestock rearing, the livestock income in real terms declined.

4.2.13. Soil and water conservation

There was general improvement in the knowledge and practising of soil conservation in the watershed areas(Plate 6). The adoption of soil and water conservation measures was

Table 4.39. Income pattern of the sample farmers in *Naranganam* watershed (Rs/ ha)

Sl.No.	Crops	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Pepper	17280	21760	19170	10.94	20160	17760
2	Banana	30114	34758	30621	1.68	33750	29733
3	Rubber	25262	29104	25640	1.50	28628	25221
4	Coconut	16224	21216	18691	15.21	18720	16492
5	Paddy	15798	19590	17258	9.24	18480	16280
	Mean	**20, 936**	**2, 5286**	**22, 276**	**6.40**	**23, 948**	**21, 097**

Table 4.40. Livestock status of the sample farmers in *Naranganam* watershed (No. / farm)

Sl.No.	Category	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Cow	1.3	1	1
2	Goat	1	1	1
3	Pig	0	0	0
4	Poultry	1	4	4

mainly the form of rain pitting, contour bunding, live fencing, mulching, rain pits, intercropping, cover cropping and contour cropping (Table 4.43 and Fig. 4.7). The adoption of soil and water conservation measures was low by non beneficiary farmers.

Table 4.41. Cost of livestock production in *Naranganam* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Concentrate	3806	4255	3749	4357	3839
2	Dry fodder	712	628	553	773	681
3	Labour charge	790	820	722	807	711
4	Miscellaneous expenses	300	364	321	420	370
Total		**5608**	**6067**	**5345**	**6357**	**5601**

Table 4.42. Livestock Income in *Naranganam* watershed (Rs/animal/year)

Sl.No	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003 04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Milk	9876	10337	9107	9942	8759
2	Dung	2065	2764	2435	2450	2158
Total		**11, 941**	**13, 101**	**11, 542**	**12, , 392**	**10, 917**

Table 4. 43. Adoption of soil and water conservation measures in *Naranganam* watershed (no. of the respondents)

Sl. No	Category	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Contour bunding	0	8 (16)	1
2	Live fencing	12 (24)	22 (44)	4 (16)
3	Mulching	20 (40)	29 (58)	5 (20)
4	Rain pit	2 (4)	41 (82)	6 (24)
5	Intercropping	5 (10)	10 (20)	6 (24)
6	Water harvesting	0	15 (30)	0
7	Multiple cropping	0	2 (4)	0
8	Multi tier cropping	0	2 (4)	0

(Figures in parentheses indicate percentage to the respective totals)

4.2.14. Organic matter content of the soil

The organic matter content analysis of soil samples collected from beneficiary as well as the control plots revealed that the organic matter ranged from 0.5 to.1.5 percent in the case of beneficiary farmers, with a mean value of 0.8. In the control plots, the range was from 0.9 to 1.5 per cent, with a mean value of 1.1. It indicated that the soil fertility status of the beneficiaries did not show any improvements on account of the programme.

4.2.15. Ground water status

The number of wells owned by the beneficiaries and non-beneficiaries are shown in Table 4.44. Out of the 50 beneficiaries, 48 of them owned wells and 7 had ponds in their households. Six of the beneficiaries had availed the benefits of renovation of well and 2 for the renovation of ponds (Table 4.44). In the non-beneficiary group, 25 households had open dug wells while none had ponds.

Table 4.44. Assistance for renovation of wells and ponds in *Naranganam* watershed (Number)

Sl.No	Respondents	Well	Pond
1	Beneficiaries	48 (6)	7 (2)
2	Non Beneficiaries	25 (0)	0 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

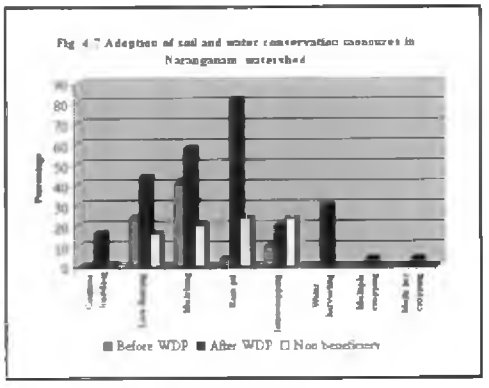
Table 4.45. Depth of Groundwater in *Naranganam* watershed (meters)

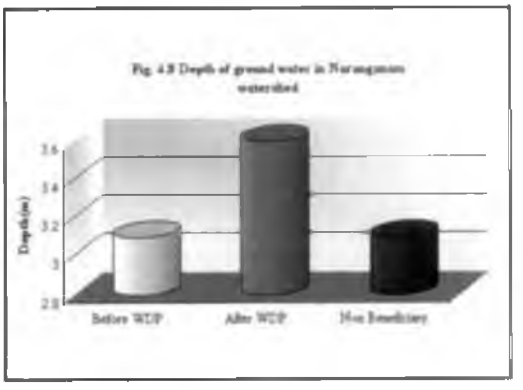
Sl.No	Beneficiary	Before WDP	After WDP	Percentage increase
a	Lowest	1.2	1.4	16.7
b	Highest	5.0	5.7	14
c.	Average	3.1	3.6	16.1
	Non Beneficiary			
a	Lowest	-	1.2	-
b	Highest	-	4.8	-
c.	Average	-	3.1	-

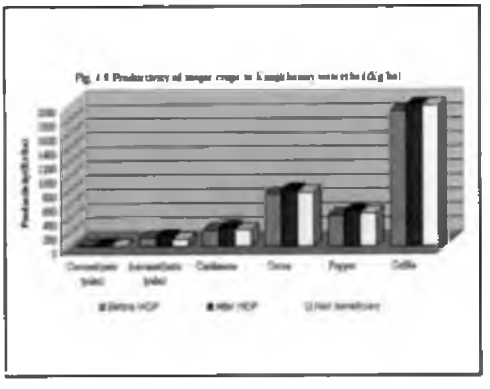
A study on average depth of ground water indicated that the average water level has increased in the post project period for the beneficiary farmers (Table 4.45 and Fig. 4.8). This could be due to the ground water recharge on account of soil and water conservation measures. The non-beneficiaries did not feel the advantage on ground water recharge.

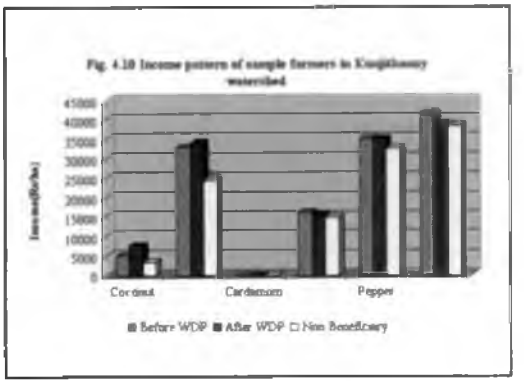
4.2.16. Distribution of inputs for Beneficiaries

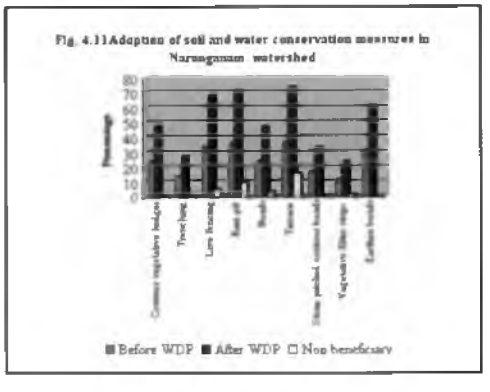
The details of input distribution in the watershed are given in Table 4.46. Only 350 seedlings were distributed in the watershed for agro forestry and green cover, out of which 170 were pepper cuttings and 160 banana suckers. The distribution planting materials were

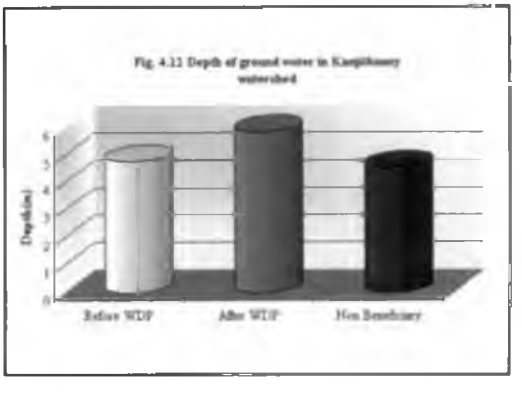

Percentage
Before WDP
After WDP
Non beneficiary


Depth (m)
Before WDP
After WDP
Non Beneficiary




Coconut
Cardamom
Pepper
Before WDP
After WDP
Non Beneficiary


Percentage
Before WDP
After WDP
Non beneficiary


Depth (m)
Before WDP
After WDP
Non Beneficiary

done through the Krishi Bhavan. This is considered as an inadequate number by the evaluation team in the context of either agro forestry or green cover. In the case distribution of fertilizers, private agencies played a major role during both before and after WDP periods with 1591 Kg and 91478 Kg respectively. Before WDP period private agencies alone was involved in distribution of fertilizers, but after WDP, the *Krishi Bhavan* and Co-operatives also came into the picture. Under distribution of mechanical equipments, one tiller was given to *Padashekara* Committee.

Table 4.46. Distribution of inputs for Beneficiaries

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	co-op	Total	KB	Private	NGO	Co-op	Total
Planting materials (number)	150	0	0	0	150	350	0	0	0	350
Fertilizer (Kg)	0	1591	0	0	1591	8695	91478	0	4440	104573
PPchemicals (ml)	0	750	0	0	750	0	750	0	0	750
Mechanical equipment Tiller (number)	0	0	0	1	1	0	0	0	1	1

Table 4.47. Allocation and Utilization of budget in *Naranganam* watershed

Sl.No.	Components	Allocation of funds (Rs)	% to total
A	Management components	-	-
B	Development component		
I	Arable land		
	Sub total on conservation measures	***11,59,285***	***53.54***
II	Non arable land		
	Sub total for conservation measures	***3,16,609***	***14.62***
	Sub Total for drainage treatment	***6,89,290***	***31.84***
	Sub total for non arable land	***10,05,899***	***46.46***
	Grand Total	**21, 65,184**	**100.00**

4.2.17. Allocation and Utilization of budget in *Naranganam* watershed

The allocation and utilization of budget in *Naranganam* watershed is presented in Table 4.47. It can be observed that an amount of Rs.21.65 lakh was spent on development component, out of which nearly 54 per cent was allotted and utilized for conservation measures on the arable land. The conservation measures on the non arable land received about 15 per cent of the total outlay. It consisted of construction of loose boulder check dams. Livestock management was totally ignored, and left out of the programme. Similarly, management components also did not appear to have received any allotment.

4.2.18. Constraints in the programme

The constraints in the watershed development programme is given in Table 4.48. Scores were given to the various constraints and based on the total scores they were ranked. On analyzing we can observe that the greatest constraint in the implementation of development programmes was political interference followed by insufficient credit availability from financial institutions and non-availability of irrigation water. It is an irony that in spite of increased water availability, a problem like non-availability of irrigation water persists in the area.

Table 4.48. Constraints in the watershed development programme

Sl.No.	Constraint	Rank
1	Political interference	1
2	Insufficient credit availability	2
3	Non-availability of Irrigation water	3
4	Lack of awareness about the beneficial programme	4
5	Inadequacy of sanctioned amount	5
6	Lack of technical guidance	6
7	Untimely availability of inputs and subsidy from Krishi Bhavan	7
8	Lack of supervision and follow-up	8
9	Others	9

The following conclusions are made from the above analyses:

- The watershed is having gentle to steep slope. It has severe soil erosion problem on account of the slope gradient. In general, the soils have low fertility status. It requires careful soil conservation measures.

- The programme could result in high adoption of soil and water conservation practices in the area. The notable among them are renovation of wells and ponds, rain pitting, intercropping, cover cropping, mulching and live fencing. This resulted in farm asset creation among beneficiary farmers.

- There is increased water harvesting in the watershed area. The average water table recorded an increase by 16 per cent, suggesting that the programme could result in groundwater recharge.

- However, the measures for non-arable land were weak, especially in bringing additional green cover.

- There was no impact on cropping pattern or cropping intensity. The number of planting materials distributed was insignificant to make any impact.

- There was no impact on soil fertility status also.

- All the major crops cultivated in the area had an increase in crop productivity. On an average, crop productivity increased by 15 percent in rubber and banana to 30 per cent in coconut.

- The gain in crop productivity was accompanied by gain in crop income in nominal as well as real terms. On an average, the farm income increased by 6.40 per cent in real terms. The increase was modest in banana, rubber and paddy, but substantial in coconut (15.21 %).

- However, the livestock status did not show any change except the poultry segment. There was no effort to increase the green fodder cultivation and availability. The livestock income recorded a decrease in real terms during this period.

- The programme could generate additional employment generation on account of the increased in labour use in agriculture. The increase was nearly 15 per cent per ha cultivated, the highest being in coconut (20 per cent).

- There was improvement in stream bank stabilization and better drainage facilities developed on account of the programme. The quality of the civil works was also satisfactory.

- The effectiveness of the training programme was manifested in the higher rate of adoption of soil and water conservation measures. This was also evident in the continuation of mulching, live fencing etc., indicating sustainability of conservation measures adopted.

- The project failed to make any impact on women and landless people, and on the availability of firewood. The inter-agency coordination between the participating agencies was low, especially with respect to Department of Dairying and Forest.
- People's participation in project planning and implementation was also low in the programme. That is why in spite of making impact on ground water status and improved water availability; non-availability of water continued to be persisting in the project area.
- Political interference, inadequacy of amount sanctioned, inadequate credit support, non-availability of water, and lack of awareness were the major constraints encountered.

4. 3. KUNJITHANNY WATERSHED

4.3.1. Family size

The distribution of respondents based on family size showed that 98 per cent of the beneficiary households had family size upto 5 members (Table 4.49). A more or less similar trend was observable for the non beneficiary households also. The family size of 96 per cent of the non beneficiary households had a family size up to 5 members.

4.3.2. Age

The classification of respondents on the basis of age is given in Table 4.50. Majority of the beneficiaries (72 per cent) belonged to the age group between 35-55. This was 56 per cent for the non beneficiary farmers. Though the aged members were slightly higher in the non beneficiary group, there was no significant difference in this regard.

Table 4.49. Family size of the sample farmers in *Kunjithanny* watershed

Sl.No.	Family size	Beneficiaries	Non-beneficiaries
1	Less than 5	49 (98)	24 (96)
2	6-7	1 (2)	1 (4)
3	Above 7	0	0
	Total	**50** **(100)**	**25** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

Table 4.50. Age wise distribution of the sample farmers in *Kunjithanny* watershed

Sl.No	Age group (Years)	Beneficiaries	Non-beneficiaries
1	Less than 35	2 (4)	2 (8)
2	35-55	36 (72)	14 (56)
3	More than 55	12 (24)	9 (36)
	Total	**50** **(100)**	**25** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

4.3.3. Educational status

The results as shown in Table 4.51 revealed that majority of the beneficiaries

Table 4.51. Educational level of the sample farmers in *Kunjithanny* watershed

Sl.No	Educational level	Beneficiaries	Non-beneficiaries
1	Illiterate	5 (2.49)	0 (0)
2	SSLC	142 (70.65)	95 (91.35)
3	Graduation	47 (23.38)	9 (8.65)
4	Post graduation	7 (3.48)	0 (0)
	Total	**201** **(100)**	**104** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

had secondary school education (70.65 per cent and 91.35 per cent respectively for the beneficiary and non beneficiary farmers). It is interesting to note that there were illiterates as well as postgraduates among the beneficiaries while these two groups were absent among the non-beneficiaries.

4.3.4. Family Income

The Income status of the sample respondents is presented in Table 4.52. It could be noticed that 46 per cent of the beneficiary farmers earned more than Rs. One Lakh of

Table 4.52. Annual family income of the sample farmers in *Kunjithanny* watershed

Sl.No.	Family income per annum (Rs)	Respondents	
		Beneficiary	Non-beneficiary
1	Less 50, 000	6 (12.00)	2 (8.00)
2	50, 000-100,000	21 (42.00)	15 (60.00)
3	Greater than 100, 000	23 (46.00)	8 (32.00)
	Total	**50 (100.00)**	**25 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

annual family income, where as 32 per cent of non beneficiary farmers had this income level. Majority of the non beneficiary farmers (60 per cent) had an income between Rs.50000-to Rs. One Lakh.

4.3.5. Land use pattern

The watershed development programme brought about changes in the pattern of land use for agriculture. There was a marginal increase in the area used for agricultural purpose by

Table 4.53. Land use pattern of the sample farmers in *Kunjithanny* watershed

Sl.No.	Land use	Beneficiaries		Non-beneficiaries
		Before WDP	After WDP	
1	Agriculture	1.13	1.16	1.12
2	Non agriculture	0.05	0.02	0.05
	Total	**1.18**	**1.18**	**1.17**

the beneficiaries (Table 4.53). The change could be attributed to the newly introduced agro forestry as well as fodder cultivation components.

4.3.6. Cropping pattern of the respondents

Table 4.54. Cropping pattern of the sample farmers in *Kunjithanny* watershed (ha)

Sl.No.	Crops	Beneficiaries	Non-beneficiaries
1	Coconut	0.12 (10.17)	0.19 (16.97)
2	Pepper	0.19 (16.10)	0.19 (16.97)
3	Cocoa	0.12 (10.17)	0.11 (9.83)
4	Coffee	0.23 (19.49)	0.30 (26.79)
5	Arecanut	0.03 (2.54)	0.05 (4.47)
6	Cardamom	0.49 (41.53)	0.28 (24.97)
	Total	**1.18 (100.00)**	**1.12 (100.00)**

(Figures in parentheses indicate the number of respondents who availed benefits)

The analysis of the cropping pattern of the respondents showed that cardamom occupied nearly 42 per cent of the total cropped area of the beneficiary farmers (Table 4.54). This was followed by coffee (19.49 per cent), pepper (16.10 per cent) and coconut (10.17 per cent). A more or less similar cropping pattern was found on the non beneficiary farms also.

4.3.7 Cropping Intensity

The cropping intensity of the sample farmers in the watershed are presented in Table 4.55. It can be noted that there was no significant difference in the cropping intensity of of beneficiary and non beneficiary farmers.

Table 4.55. Cropping intensity of the sample farmers in *Kunjithanny* watershed

Sl.No.	Category	Gross sown area (ha)	Net sown area (ha)	Cropping intensity (%)
1	Beneficiary	1.18	1.16	101.72
2	Non-beneficiary	1.12	1.11	100.90

4.3.8. Labour use pattern

The labour use pattern of the sample farmers in the pre and post project period is shown in Table 4.56. It can be noted that the project resulted in an increase in labour use in the case of beneficiaries. There was, on an average 12 per cent increase in labour use, coconut registering the highest change (71 %).

Table 4.56. Labour use pattern of the sample farmers in *Kunjithanny* watershed (labour days per ha)

Sl.No.	Crops	Beneficiary			Non beneficiary	% change over control
		Before WDP	After WDP	% change over time		
1	Coconut	14	24	71.43	15	60.00
2	Arecanut	100	115	15.00	113	1.77
3	Cardamom	249	250	0.40	241	3.73
4	Cocoa	47	58	23.40	53	9.43
5	Pepper	109	133	22.02	95	40.00
6	Coffee	120	141	17.50	135	4.44
	Mean	**107**	**120**	**12.15**	**109**	**10.09**

4.3.9. Productivity of major crops

The productivity of major crops in the project area before and after investment and in control group is presented in Table 4.57. It can be seen that the productivity of major crops in the watershed has shown considerable increase. The productivity increased from about 5 per cent in coffee to 15-17 per cent in arecanut and cardamom. The increase was highest for coconut. It recorded an increase in productivity by 75 per cent. The productivity of all the major crops in the beneficiary farms were higher than that of non beneficiaries(Fig. 4.9).

4.3.10. Crop wise farm expenses

The cost of cultivation of the major crops grown in the watershed area are estimated and compared over the project period in real terms using constant prices (Table 4.58, 4.59, 4.60, 4.61, 4.62 and 4.63). Input wise analysis of farm expenses revealed that human labour was the major cost item in all the crops.

Table 4.57. Productivity of major crops in *Kunjithanny* watershed

Sl.No.	Crops	Beneficiary			Non beneficiary	% change over control
		Before WDP	After WDP	% change over time		
1	Coconut (nuts /palm)	8	14	75.00	6	33.33
2	Arecanut (nuts /palm)	121	142	17.36	102	39.22
3	Cardamom (Kg/ha)	225	259	15.11	235	10.21
4	Cocoa (Kg/ha)	732	796	8.74	766	3.92
5	Pepper (Kg/ha)	438	498	13.70	462	7.79
6	Coffee (Kg/ha)	1901	1992	4.79	1983	2.79

The cost of cultivation of coffee increased by 1.35 per cent during the project period. The increase was more on account of increase in expenditure on human labour than on material inputs like manures and fertilizers. In fact, the expenses on manures declined in coffee at constant prices.

Table 4. 58. Input wise farm expenses for cardamom crop in *Kunjithanny* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	27,420	31,256	27,537	30,090	26,509
2	Seeds	450	525	463	0	0
3	Manures	6950	8115	7149	7950	7004
4	Fertilizers	3050	3650	3216	3205	2824
5	PP chemicals	1998	2300	2026	2250	1982
	Total	**39, 868**	**45, 846**	**40, 391**	**43, 495**	**38, 319**

The cost of cultivation of cardamom increased by 1.31 per cent during the project period. The increase was more on account of increase in expenditure on material inputs like manures and fertilizers.

Table 4. 59. Input wise farm expenses for coffee crop in *Kunjithanny* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	13,200	15,520	13,673	14,850	13,083
2	Seeds	0	0	0	0	0
3	Manures	3330	3680	3242	3420	3013
4	Fertilizers	600	720	634	750	661
5	PP chemicals	1750	1800	1586	2200	1938
	Total	**18, 880**	**21, 720**	**19, 135**	**21, 220**	**18, 695**

Table 4. 60. Input wise farm expenses for pepper crop in *Kunjithanny* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	12,020	14,600	12,863	10,450	9206
2	Seeds	630	820	722	730	643
3	Manures	4800	5700	5022	5950	5242
4	Fertilizers	360	436	384	330	291
5	PP chemicals	560	673	593	550	485
	Total	**18, 370**	**22, 229**	**19, 584**	**18, 010**	**15, 867**

The cost of cultivation of pepper increased by 6.61 per cent during the project period. The increase was more pronounced in the case of expenditure on human labour (7.01 %). The expenses on material inputs like manures (4.63 %) fertilizers (6.67 %) and plant protection chemicals (5.89 %) also increased during this period.

Table 4. 61. Input wise farm expenses for coconut crop in *Kunjithanny* watershed (Rs/ha)

Sl.No	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	1540	2640	2323	1650	1454
2	Seeds	0	0	0	0	0
3	Manures	1020	1360	1197	964	849
4	Fertilizers	0	0	0	0	0
5	PP chemicals	920	860	757	984	867
	Total	**3480**	**4860**	**4277**	**3598**	**3170**

Table 4. 62. Input wise farm expenses for arecanut crop in *Kunjithanny* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,960	12,680	11,158	12,380	10,907
2	Seeds	0	0	0	0	0
3	Manures	780	970	854	750	661
4	Fertilizers	375	356	313	390	344
5	PP chemicals	0	0	0	0	0
	Total	**12, 115**	**14, 006**	**12; 325**	**13, 520**	**11, 912**

The increase in expenses for the cultivation of coconut, arecanut and cocoa could be attributed to the increased expenses on use of human labour, manures and fertilisers. The use of plant protection chemicals showed a decrease in the case of crops like cardamom and cocoa.

Table 4.63. Input wise farm expenses for cocoa crop in *Kunjithanny* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	5150	6390	5630	5850	5154
2	Seeds	520	630	555	0	0
3	Manures	4550	5675	5000	4350	3832
4	Fertilizers	1530	1350	1189	1250	1101
5	PP chemicals	950	870	766	820	722
	Total	**12,700**	**14,915**	**13,140**	**12,270**	**10,809**

4.3.11. Income pattern

The farm income pattern of the farmers in the project area is depicted in Table 4.64. The mean average farm income did not show much difference between the beneficiary and non beneficiary farmers.

Table 4.64. Income pattern of the sample farmers in *Kunjithanny* watershed(Rs/ha)

Sl. No.	Crops	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Coconut	4992	8736	7696	54.17	3744	3298
2	Arecanut	32,912	38624	34028	3.39	27744	24442
3	Cardamom	1,39,500	1,60,580	1,41,471	1.41	1,45,700	1,28,362
4	Cocoa	16104	17512	15428	-4.20	16852	14847
5	Pepper	35040	39840	35099	0.17	36960	32562
6	Coffee	41822	43824	38609	-7.68	43626	38435
	Mean	**45, 062**	**51, 519**	**45, 389**	**0.73**	**45, 771**	**40, 324**

A crop wise analysis of the farm income per hectare revealed that income from coffee and cocoa underwent a decline. This could mainly be attributed to the drastic fall in prices in these two crops, and the subsequent crisis in the plantation sector in the whole district rather than on account of any negative impact of the programme. On the other hand, farm income from crops like pepper, cardamom and arecanut recorded modest increase. The highest increase in earnings was from coconut(Fig. 4.10).

4.3.12. Livestock Status

Cow, poultry and goat were the main livestock reared in the area. The livestock population of beneficiary farmers was higher than that of the non beneficiary farmers (Table 4.65).

Table 4.65. Livestock status of the sample farmers in *Kunjithanny* watershed (No. / farm)

Sl.No.	Category	Beneficiaries	Non beneficiaries
1	Cow	15 (21.74)	12 (20)
2	Goat	19 (27.54)	13 (21.67)
3	Pig	5 (7.25)	0 (0)
4	Poultry	30 (43.48)	35 (58.33)
	Total	**69 (100)**	**60 (100)**

(Figures in parentheses indicate the number of respondents who availed benefits)

Table 4.66. Cost of livestock production in *Kunjithanny* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At current Prices (2003-04)	At constant Prices (1998-99)
			At current Prices (2003-04)	At constant Prices (1998-99)		
1	Concentrate	3950	4875	4295	3860	3400
2	Dry fodder	2150	1730	1524	2000	1762
3	Labour charge	5900	7200	6343	5800	5109
4	Miscellaneous expenses	1400	1160	1022	1550	1366
	Total	**13, 400**	**12, 340**	**13,184**	**13, 210**	**11, 637**

There were differences in cost of maintenance incurred by beneficiary and non beneficiary farmers. The cost on labour charges and concentrate feed incurred were higher for the beneficiary farmers, but their expenditure on fodder was lower (Table 4.66). It is evident from Table 4.67 that the farmers earned profit through livestock rearing. There has been an increase in the profit earned by the beneficiary during the project period (Table 4.67). It could partly be attributed to the increased availability of fodder and lesser expenditure incurred on this input on account of it.

Table 4.67. Livestock Income in *Kunjithanny* watershed

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Milk	12,960	14975	13193	13000	11453
2	Dung	1325	1700	1498	1520	1339
	Total	**14, 285**	**16, 675**	**14, 691**	**14, 700**	**12, 792**

4.3.13. Soil and water conservation

The details of adoption of soil and water conservation measures are available from Table 4.68.

Table 4.68. Adoption of soil and water conservation measures in *Kunjithanny* watershed

Sl.No.	Category	Beneficiary		Non beneficiary
		Before WDP	After WDP	
1	Contour vegetative hedges	24	48	0
2	Trenching	14	28	0
3	Live fencing	34	68	5
4	Rain pit	36	72	10
5	Bunds	24	48	3
6	Terrace	37	74	16
7	Stone pitched contour bunds	17	34	0
8	Vegetative filter strips	12	24	2
9	Earthen bunds	31	62	0

It may be noted that soil and water conservation measures adopted by the beneficiary farmers were higher during the post project period, indicating general improvement in the knowledge and practice of soil conservation in the watershed area. The practice of terracing, live fencing rain pitting and construction of earthen were the common practice in the watershed area(Fig.4.11). However, the species used for live fencing were *erythrina* and *lentana*. More appropriate species like *glyricidia* or *hibiscus* could have been selected. There were no follow up with the result that the live fences had dried off in many areas with poor survival. It was gathered that the implementation of the project activities were entrusted to private contractors by the implementing agency, who were neither technically oriented nor trained to carry out such project activities. This institutional drawback proved the major bottleneck of the programme in the watershed under reference, and against the spirit of participatory watershed development.

4.3.14. Organic matter content of the soil

The organic matter content of the soil was analyzed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 2.8 to 4.4 percent in the beneficiary sample with a mean of 3.5. In the control plot the range was from 3.5to 4.9 per cent and the mean was 4. The average content of organic matter in the soil was higher for the non beneficiaries when compared to the beneficiaries. Even though there is a difference in the organic matter content of both the beneficiary and non beneficiary sample, the difference could not be due to any negative impact of the programme.

4.3.15. Ground Water Status

In order to harvest the rainwater to increase the water table, moisture content and vegetative cover, assistance was given to 7 farmers for the renovation the wells and one for the renovation of pond (Table 4.69).

Table 4.69. Assistance for rain water harvesting structures in *Kunjithanny* watershed (Number)

Sl.No.	Respondents	Well	Pond
1	Beneficiaries	39 (7)	2 (1)
2	Non Beneficiaries	20 (0)	0 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

A comparison of the average depth of ground water indicated that there is difference in the depth of groundwater before WDP and after WDP in the beneficiary farms (Table 4.70). There was an increase in the groundwater level by 22 per cent, indicating the positive impact of the programme on the ground water status of the beneficiaries(Fig. 4.12).

Table 4.70. Depth of Ground water in *Kunjithanny* watershed (in meters)

Sl.No.	Beneficiary	Before WDP	After WDP	Percentage increase
A	Lowest	0.76	0.84	10.52
B	Highest	8.86	10.92	23.25
c.	Average	4.81	5.88	22.25
	Non beneficiaries			
A	Lowest	-	0.44	-
B	Highest	-	8.73	-
c.	Average	-	4.59	-

4.13.16. Distribution of Inputs

The details of distribution of inputs are furnished in Table 4.71. A total of 52,744 seedlings of arecanut, coffee, nutmeg graft and mahogany were distributed as detailed below. It is understood that quotations were invited from private nurseries for the supply of seedlings, and the procured seedlings were distributed through the *Kunjithanny Krishi Bhavan*.No other inputs like manures, fertilizers, plant protection chemicals or implements were distributed.

4.1.18. Allocation and Utilization of watershed budget

The details of allocation and utilization of watershed budget are depicted in Table 4.72. It can be seen that the development component accounted for the total project outlay of Rs.32.81 lakhs.

The project did not earmark any amount for basic activities like biophysical and socioeconomic surveys. Hence, it is assumed that the projectisation was carried out with out any integrated surveys. This could have been a major deterrent in identifying the project

Table 4.71. Distribution of inputs for Beneficiary in *Kunjithanny* watershed

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	KAU	Total	KB	Private	KAU	Co-op	Total
Planting materials (no)	0	0	0	0	0	52,744	0	0	0	52,744
Arecanut	0	0	0	0	0	5333	0	0	0	0
Coffee	0	0	0	0	0	37372	0	0	0	0
Nutmeg	0	0	0	0	0	400	0	0	0	0
Mahogany	0	0	0	0	0	9639	0	0	0	0
Fertilizer (no:)	0	0	0	0	0	0	0	0	0	0
PP chemicals(ml)	0	0	0	0	0	0	0	0	0	0
Mechanical equipment (no)Tiller	0	0	0	0	0	0	0	0	0	0

components ins need based manner. In the event of no funds earmarked for the training of staff, *mithra kissans* and farmers, it is again assumed that no such trainings were undertaken. Nearly 76 per cent of the project budget was spent on conservation of arable land, while about 5 per cent was spent on conservation of non arable land. Nearly 18 per cent of the project fund was utilized for drainage treatment.

4.3.17. Constraints in the watershed development programme

The major constraint of the programme as perceived by the stakeholders was political interference (Table 4.73). Inadequacy of sanctioned amount, lack of supervision and follow-up, untimely distribution of inputs and subsidy from *Krishi Bhavan*, and lack of technical guidance were the other main constraints. The evaluation team came across complaints regarding the constitution of the watershed committee, selection of beneficiaries and the quality of civil works and live fencing. The team feels that greater care is required in this area while implementing similar programmes in future.

The following conclusions are drawn from the above analyses:

- The watershed is situated in very steep mountain slopes with rock escarpments. Since the upper slopes are very steep, the water velocity during monsoon is very high and this causes stream bank drainage and erosion problems. Majority of the stream

Table 4.72. Allocation and Utilization of budget in *Kunjithanny* watershed

Sl.No.	Components	Allocation of funds (Rs)	% to total
A	Management components	-	-
B	Development component		
I	Arable land		
	Contour vegetative hedges	5084	0.15
	Repair of old soil conservation works	22,31,993	68.02
	Earthen bunds	1,80,884	5.51
	Centripetal terrace	50,906	1.55
	Moisture conservation pits	16,565	0.50
	Sub Total for conservation measures	***24,85,432***	***75.74***
II	Non arable land		
	Contour vegetative hedges	54,372	1.66
	Live fencing	1,62,735	4.96
	Sub Total for conservation measures	***2,17,107***	***6.62***
	Drainage line treatment		
	Bank stabilization	4,80,270	14.64
	Live check dams	18,600	0.57
	Brush wood check dams	27,600	0.84
	Loose boulder check dams	52,500	1.60
	Sub Total for drainage line treatment	***5,78,970***	***17.64***
	Grand Total	**32, 81, 509**	**100.00**

of the upper slopes dry up during summer and water scarcity is also. Very steep slopes are used for cultivation purposes and unscientific management practices such as cropping across the slope enhance the erosion status.

- There was higher adoption of soil and water conservation practices such as rainwater pitting, contour vegetative hedging, live fencing etc. However, the evaluation team is of the opinion that contour vegetative hedging was not suitable to such steep watershed areas. The selection of the species for live fencing was also no appropriate. This raised serious questions on the sustainability measures of the farm assets created.

- The programme could improve ground water status in the watershed area through increased water harvesting. There raise in water table, which was instrumental in

Table 4.73. Constraints in the watershed development programme in *Kunjithanny* watershed

Sl.No.	Constraint	Rank
1	Political interference	1
2	Inadequacy of sanctioned amount	2
3	Lack of supervision and follow-up	3
4	Untimely availability of inputs and subsidy from Krishi Bhavan	4
5	Lack of technical guidance	5
6	Insufficient credit availability	6
7	Non-availability of Irrigation water	7
8	Lack of awareness about the beneficial programme	8
9	Misappropriation of funds	9

enhancing crop productivity. On an average, the productivity of major crops recorded an increase of 5-15 percent, the highest being in coconut (75 %).

- The increased crop productivity could not be converted into higher farm income in real terms for all the crops. The average farm income increase was very modest (0.73 %). Crops like coconut, and arecanut recorded increase in income while it was negligible for cardamom and pepper. Crops like coffee and cocoa registered decline in income per ha though it cannot be related in the context of the watershed development programme alone.

- There was an increase in employment generation on account of the increased labour use in farming during the post project period. The labour use on an average increased by 12 per cent after the implementation of the watershed development programme. There was an increase from 0.40 per cent in cardamom to 22-23 per cent in pepper and cocoa. The highest change was in the case of coconut (71 %).

- The project could not make any visible impact on green cover and microclimate, cropping pattern, cropping intensity, soil fertility status and level of education.

- No schemes were designed to have conservation measures in non-arable land, for increasing firewood, and for women and landless households. The treatment of no arable land is very crucial for the success of watershed development programmes.

- There was increased fodder availability to the beneficiary farmers.

- No impact was noted with respect to increased efficiency in stream bank stabilization or drainage facilities. There were indications of poor quality of civil works undertaken.

- There was an increase in livestock income during the project period.
- The inter-agency coordination between the Department of Agriculture, Department of Soil Conservation, Department of Animal Husbandry, and the Department of Dairying were low. The Forest Department Minor or Irrigation Department was not represented in the watershed committee even though interface forestry and minor irrigation components were involved.
- The maintenance of civil works and live fences were poor.
- Contrary to the principle of people's participation in project planning and implementation, the of implementation was entrusted to private contractors. Any programme of this nature cannot make an impact with out people's cooperation and participation. The evaluation team came across complaints regarding the constitution of the watershed committee, selection of beneficiaries, and the quality of civil works and live fencing.
- Political interference, inadequacy of amount sanctioned, lack of supervision and follow up, lack of technical guidance and delay in the availability of inputs from the *Krishi Bhavan* were the major constraints encountered.

4.4. UPPUKANDAM WATERSHED

4.4.1. Family size

The distribution of respondents based on family size showed that majority of households had small size (family size up to 5 members). There was no significant difference in the family size the beneficiary and non beneficiary group.

Table 4.74. Family size of the sample farmers in *Uppukandam* watershed

Sl.No	Family size	Beneficiaries	Non-beneficiaries
1	Upto 5	45 (90)	22 (88)
2	6-7	5 (10)	3 (12)
3	Above 7	0	0
	Total	**50** **(100)**	**25** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

4.4.2 Age

The classification of respondents on the basis of age as shown in Table 4.75. It revealed that 60 per cent of the beneficiaries belonged to the age group between 35-55 years, while 68 per cent of the non beneficiaries belonged to this age group. There was not much difference in the age pattern of beneficiary and non beneficiary farmers.

Table 4.75. Age group of the sample farmers in *Uppukandam* watershed

Sl.No	Age group (Years)	Beneficiaries	Non-beneficiaries
1	Less than 35	1 (2)	1 (4)
2	35-55	30 (60)	17 (68)
3	Greater than 55	19 (38)	7 (28)
	Total	**50** **(100)**	**25** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

4.4.3 Educational status

The educational background of the people of the project area is also a factor that influences the implementation of government sponsored programmes. The illiterate and poor people may hesitate to accept the programmes, requiring intensive training and demonstration for conviction.

Table 4.76. Educational level of the sample farmers in *Uppukandam* watershed

Sl.No	Educational level	Beneficiaries	Non-beneficiaries
1	Illiterate	6 (2.67)	4 (3.74)
2	SSLC	166 (73.78)	88 (82.24)
3	Graduation	45 (20)	15 (14.02)
4	Post graduation	8 (3.55)	0 (0)
	Total	**225** **(100)**	**107** **(100)**

(Figures in parentheses indicate percentage to the respective totals)

The results as shown in Table 4.76 revealed that majority of the beneficiaries and non beneficiaries had secondary school attainment (73.78 and 82.24 percentages respectively). There were illiterate farmers in both groups. However, postgraduate farmers were present in the beneficiary group only.

4.4.4 Family Income

An analysis of Table 4.77 indicated that majority of the farmers in both the category were having an annual family income of more than one lakh rupees. Very few farmers had an annual income of less than Rs.50,000/.

Table 4.77. Annual family income of the sample farmers in *Uppukandam* watershed

Sl.No.	Family income per annum (Rs)	Respondents	
		Beneficiary	Non-beneficiary
1	Less 50, 000	5 10.00)	3 (12.00)
2	50, 000-100,000	18 (36.00)	9 (36.00)
3	Greater than 100, 000	37 (54.00)	13 (52.00)
	Total	**50** **(100.00)**	**25** **(100.00)**

(Figures in parentheses indicate percentage to the respective totals)

4.4.5 Land use pattern

The changes in land use pattern during the project period are shown in Table 4.78. It indicated that the area used for agricultural purposes by the beneficiaries showed an increase from 0.72 hectares per farm to 0.78, while that of non arable land decreased from 0.11 hectares to 0.05 hectares . The increase in agricultural area could be attributed to the conversion of non arable land for fodder cultivation.

Table 4.78. Land use pattern of the sample farmers in *Uppukandam* watershed

Sl.No	Land us (Owned land)	Beneficiaries		Non-beneficiaries
		Before WDP	After WDP	
1	Agriculture	0.72	0.78	0.69
2	Non agriculture	0.11	0.05	0.10
	Total	**0.83**	**0.83**	**0.79**

4.4.6. Cropping pattern of the respondents

The cropping pattern of the respondent farmers were analyzed and presented in Table 4.79.

Table 4.79. Cropping pattern of the sample farmers in *Uppukandam* watershed (ha)

Sl.No	Crops	Beneficiaries	Non-beneficiaries
1	Coconut	0.15 (19.23)	0.14 (20)
2	Pepper	0.36 (46.15)	0.32 (49.23)
3	Cocoa	0.08 (10.26)	0.04 (4.62)
4	Coffee	0.05 (6.41)	0.05 (6.15)
5	Arecanut	0.05 (6.41)	0.06 (9.23)
6	Cardamom	0.09 (11.54)	0.08 (10.77)
	Total cropped area	**0.78 (100.00)**	**0.69 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

Pepper occupied nearly 46.15 per cent of the total cropped area of the beneficiary farmers. This was followed by coconut (19.23 per cent), cardamom (11.54 per cent) and cocoa (10.26 per cent). A similar cropping pattern was evident in the case of non-beneficiary farmers also.

4.4.7 Cropping Intensity

Table 4.80. Cropping intensity of the sample farmers in *Uppukandam* watershed

Sl.No.	Category	Gross sown area (ha)	Net sown area (ha)	Cropping intensity (%)
1	Beneficiary	0.78	0.77	101.30
2	Non-beneficiary	0.69	0.69	100.00

4.4.8 Labour use pattern

The labour use pattern of the farmers are worked out and depicted in Table 4.81. An increase in labour use was visible during the project period. The average increase was by nearly 14 per cent. The increase was less pronounced for cardamom, coffee and cocoa while it was more pronounced for pepper and coconut.

Table 4.81. Labour use pattern of the sample farmers in *Uppukandam* watershed (labour days per ha)

Sl.No.	Crops	Beneficiary			Non beneficiary	% change over control
		Before WDP	After WDP	% change over time		
1	Coconut	11	20	81.82	13	53.85
2	Arecanut	16	19	18.75	28	-32.14
3	Cardamom	193	211	9.33	206	2.43
4	Cocoa	45	49	8.89	35	40.00
5	Pepper	92	120	30.43	95	26.32
6	Coffee	130	138	6.15	132	4.55
	Mean	**81**	**93**	**14.81**	**85**	**9.41**

4.4.9 Productivity of major crops

The productivity of major crops in the project area before and after investment and in the control group is presented in the following section. Productivity of pepper, which is the major crop in the watershed area, increased from 446 kg/ha to 515 kg/ha (16 % increase) while the productivity of coconut increased from 18 nuts per palm to 22 nuts per palm in the watershed area (22 % increase). The increase was modest for cocoa and coffee (Fig. 4.13). It is known that improvements in soil moisture regime and better water availability facilitates increased and efficient use of fertilizers. This would lead to an increase in crop productivity.

4.4.10 Crop wise farm expenses

The cost of cultivation of the major crops grown in the watershed area are estimated and compared over the project period in real terms using constant prices.(Table 4.83, 4.84, 4.85, 4.86, 4.87 and 4.88). Input wise analysis of farm expenses revealed that human labour was the major cost item in all the crops .

Table 4.82. Productivity of major crops in *Uppukandam* watershed

Sl.No.	Crops	Beneficiary			Non beneficiary	% change over control
		Before WDP	After WDP	% change over time		
1	Coconut (nuts /palm)	18	22	22.22	16	37.50
2	Arecanut (nuts /palm)	112	133	18.75	98	35.71
3	Cardamom (Kg/ha)	236	279	18.22	248	12.50
4	Cocoa (Kg/ha)	712	780	9.55	786	-0.76
5	Pepper (Kg/ha)	446	515	15.47	498	3.41
6	Coffee (Kg/ha)	1836	1970	7.30	1890	4.23

The cost of cultivation of pepper increased by 6.61 per cent during the project period. The increase was more pronounced in the case of expenditure on human labour and manures. The expenditure on plant protection reduced during this period.

Table 4.83. Input wise farm expenses for pepper crop in *Uppukandam* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,120	13,200	11,629	10,450	9206
2	Seeds	700	710	626	730	643
3	Manures	2800	2600	2291	2950	2599
4	Fertilizers	560	650	573	720	634
5	PP chemicals	460	360	317	550	485
	Total	**14, 640**	**17, 520**	**15, 435**	**15, 400**	**13, 567**

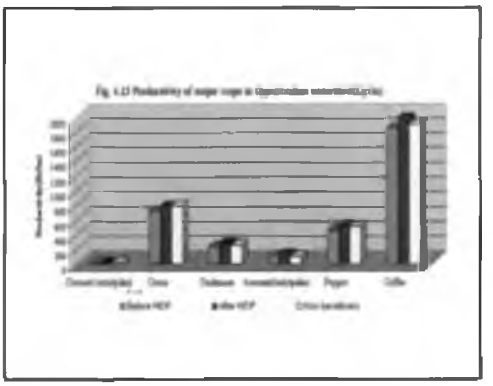
Table 4.84. Input wise farm expenses for coconut crop in *Uppukandam* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	1200	2200	1938	1400	1233
2	Seeds	40	80	70	40	35
3	Manures	920	1256	1107	864	761
4	Fertilizers	1100	760	670	984	867
5	PP chemicals	0	0	0	0	0
	Total	**3260**	**4296**	**3785**	**3288**	**2897**

Input wise analysis revealed that intensity of human labour use increased in the project period in coconut, cardamom, arecanut, coffee and cocoa also. However, increase in material inputs was marked in the use of manures in all the cases. Increased expenditure on chemical fertilizer was visible only for pepper, cardamom, and arecanut, this increase was small for pepper and arecanut.

Table 4.85. Input wise farm expenses for cardamom crop in *Uppukandam* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	21,320	26,430	23,285	25,800	22,729
2	Seeds	325	485	427	415	366
3	Manures	8050	9862	8688	9096	8013
4	Fertilizers	7650	9856	8683	9513	8381
5	PP chemicals	3250	4520	3982	4220	3718
	Total	**40, 595**	**51, 153**	**45, 065**	**49, 044**	**43, 207**



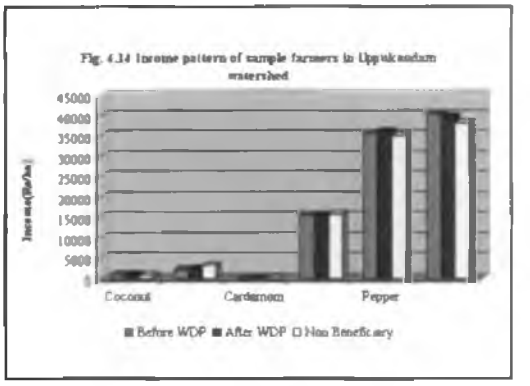


Fig. 4.14 Income pattern of sample farmers in Uppukundam watershed
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Coconut
Cardamom
Pepper
Before WDP
After WDP
Non Beneficiary

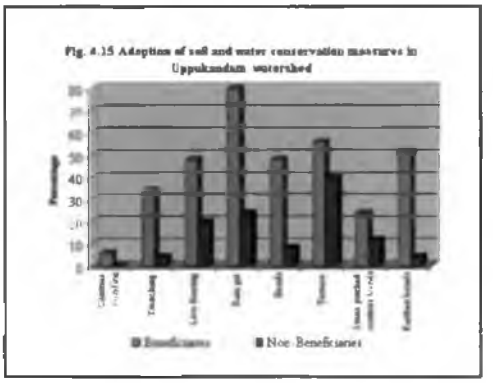


Fig. 4.15 Adoption of soil and water conservation measures in Uppukundam watershed
Percentage
Beneficiaries
Non Beneficiaries

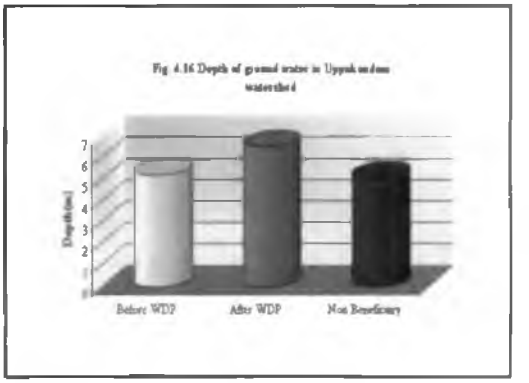
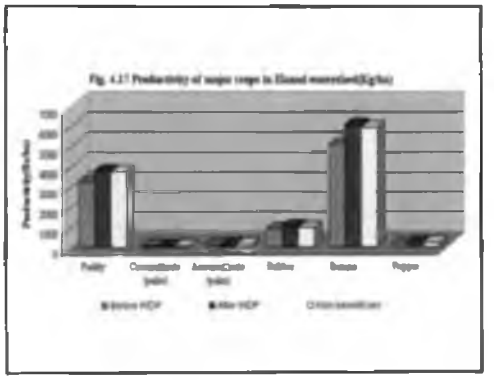


Fig 4.16 Depth of ground water in Uppukundam watershed
7
6
5
4
3
2
Before WDP
After WDP
Non Beneficiary



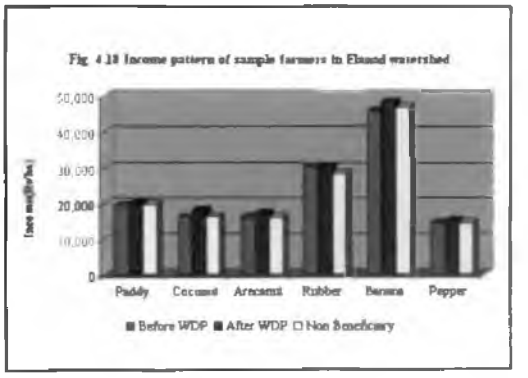


Fig. 4.18 Income pattern of sample farmers in Elumd watershed
50,000
40,000
30,000
20,000
10,000
0
Paddy
Coconut
Arecanut
Rubber
Banana
Pepper
Before WDP
After WDP
Non Beneficiary

Table 4.86. Input wise farm expenses for arecanut crop in *Uppukandam* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	1760	2090	1841	3080	2713
2	Seeds	96	176	155	120	106
3	Manures	540	725	639	640	564
4	Fertilizers	315	396	349	425	374
5	PP chemicals	0	0	0	0	0
	Total	**2811**	**3387**	**2984**	**4265**	**3757**

4.11 Income pattern

The farm income of the farmers in the project area and non project area as depicted in Table 4.89. In general, the farm income increased by 0.82 per cent only. While the income from coffee declined during this period as in the case of *Kunjithanny* watershed, income increase from cardamom, cocoa and pepper were marginal(Fig.4.14). The highest incresase in income was shown by arecanut (14.52%).

Table 4.87. Input wise farm expenses for coffee crop in *Uppukandam* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	14,300	19,180	16,898	14,520	12,792
2	Seeds	0	0	0	0	0
3	Manures	2530	2680	2361	2530	2229
4	Fertilizers	800	810	714	950	837
5	PP chemicals	1900	1850	1630	2100	1850
	Total	**19, 530**	**20, 520**	**21, 602**	**20, 100**	**17, 708**

Table 4.88. Input wise farm expenses for cocoa crop in *Uppukandam* watershed Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	4950	6390	5630	3850	3392
2	Seeds	350	370	326	340	300
3	Manures	3250	3675	3238	3650	3216
4	Fertilizers	2530	1850	1630	3250	2863
5	PP chemicals	1300	1300	1145	1560	1374
	Total	**12, 380**	**13, 585**	**11, 968**	**12, 650**	**11, 145**

4.4.12 Livestock Status

The details of livestock status of the respondent farmers are presented in Table 4.90. It could be observed that cow, poultry and goat were the main livestock reared in the area.

Table 4.89. Income pattern of the sample farmers in *Uppukandam* watershed (Rs/ha)

Sl. No.	Crops	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Coconut	990	1185	1044	5.45	1050	925
2	Arecanut	2177	2830	2493	14.52	3798	3346
3	Cardamom	1,51,040	1,72,980	1,52,395	0.90	1,53,760	1,35,463
4	Cocoa	15,664	17,940	15,805	0.90	18,078	15,927
5	Pepper	35,680	41,200	36,297	1.73	39,840	35,099
6	Coffee	40,392	45,310	39,918	-1.17	43,470	38,297
	Mean	**40, 990**	**46, 907**	**41, 325**	**0.82**	**43, 333**	**38, 176**

Table 4.90. Livestock status of the sample farmers in *Uppukandam* watershed (No. / farm)

Sl.No.	Type of livestock	Beneficiaries	Non beneficiaries
1	Cow	18	8
2	Goat	23	11
3	Pig	2	0
4	Poultry	38	21

Even though the livestock population of the beneficiary farmers appear higher than that of the non beneficiaries, it is understood that the number of livestock owned by the beneficiaries as a result of the implementation of the programme did not undergo any significant change.

Table 4.91. Cost of livestock production in *Uppukandam* watershed (Rs/animal/ year)

Sl.No	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At current Prices (2003-04)	At constant Prices (1998-99)
			At current Prices (2003-04)	At constant Prices(1998-99)		
1	Concentrate	3804	3804	3355	3832	3376
2	Dry fodder	2028	1920	1692	2300	2026
3	Labour charge	5560	5760	5075	5600	4934
4	Miscellaneous expenses	1800	960	846	1750	1542
	Total	**13, 192**	**12, 444**	**10, 968**	**13, 482**	**11, 878**

It is evident from Table 4.91 that the expenses incurred for dry fodder and labour has reduced considerably with impetus provided for fodder cultivation in the project. As a result, the livestock maintenance expenditure of the beneficiary farmers came down considerably.

Table 4.92. Livestock Income in *Uppukandam* watershed (Rs/animal/year)

Sl.No	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Milk	13650	14850	13083	13650	12026
2	Dung	1725	1500	1322	1725	1519
	Total	**15, 375**	**16, 350**	**14, 405**	**15, 375**	**13, 545**

Even though livestock rearing brought profit to the farmers, there was no increase in the income from livestock in real terms (Table 4.92).

4.4.13. Soil and water conservation measures

Excessive sedimentation, transportation and rapid nutrient depletion from surface soil were the fundamental problem in the watershed. Biotic disturbance and absence of scientific soil and water management had caused poor infiltration in this watershed, which is undulating to very steep in terrain characteristic. Poor infiltration during monsoon months caused rapid depletion in moisture condition of surface horizons and consequent moisture stress to cultivated crops during summer months. Keeping these special characteristics in mind, three types of watershed activities were taken up manly, viz., development of land resources through soil conservation works, development of water resources through *in-situ* conservation, harvesting and proper utilization of irrigation sources and agro-forestry, cultivation of fodder grass/ crops etc.

Table 4.93. Adoption of soil and water conservation measures in *Uppukandam* watershed (no: of the respondents)

Sl.No.	Category	Beneficiaries	Non-Beneficiaries
1	Contour bunding	3 (5.77)	0 (0)
2	Trenching	17 (34)	1 (4)
3	Live fencing	24 (48)	5 (20)
4	Rain pit	40 (80)	6 (24)
5	Bunds	24 (48)	2 (8)
6	Terrace	28 (56)	10 (40)
7	Stone pitched contour bunds	12 (24)	3 (12)
8	Earthen bunds	26 (52)	1 (4)

(Figures in parentheses indicate percentage to the respective totals)

The level of adoption of various soil and water conservation measures is shown in Table 4.93. It may be noted that there was general improvement in the knowledge and adoption of soil and water conservation measures in the watershed area(Fig.4.15). The practice of terracing was widely prevalent among the beneficiaries. Nearly 56 per cent of beneficiary farmers adopted this measure. This was followed by the practice of constructing earthen bunds with 52 per cent of the beneficiaries adopting this practice. Fencing with live trees as well as construction of bunds was adopted by 48 per cent of the beneficiaries. Water conservation through rain pits was adopted by 80 per cent of the beneficiaries, indicating the acceptability of this practice. It could be seen that there was less preference for the practice of contour bunding. It was also noted that while the large farmers adopted expensive conservation measures, the marginal and small farmers adopted less costly and easily adoptable practices.

4.4.14. Organic matter content of the soil

The organic matter content of the soil was analyzed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 1.1 to 3.3 per cent in the beneficiary sample with a mean of 2.2. In the control plots, the range was from 2 to 3.7 per cent with a mean value of 2.8. The average content of organic matter in the soil was higher for the non beneficiaries when compared to the beneficiaries. Even though there is a difference in the organic matter content, the difference could not be due to the implementation of the watershed programme.

4. 4.15. Ground Water Status

Table 4.94 shows the number of wells owned by the beneficiaries and non-beneficiaries.

Table 4.94. Assistance for renovation of wells and ponds in *Uppukandam* watershed (Number)

Sl.No.	Respondents	Well	Pond
1	Beneficiaries	42 (6)	5 (3)
2	Non Beneficiaries	22 (0)	1 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

Out of the 50 beneficiaries, 42 had owned wells and 5 had ponds in their households. In the non-beneficiary group, 22 households had their own well and only one household had pond. Following the implementation of watershed programme, 6 of these beneficiaries had availed the benefits provided for renovating the wells and 3 of them received the benefits for renovating the ponds.

Table 4.95. Depth of Ground water in *Uppukandam* watershed (in meters)

Sl.No	Beneficiary	Before WDP	After WDP	Percentage increase
a	Lowest	0.66	0.74	12.12
b	Highest	9.92	12.49	25.9
c.	Average	5.29	6.62	25.05
	Non beneficiaries			
a	Lowest	-	0.54	-
b	Highest	-	9.80	-
c.	Average	-	5.17	-

An evaluation of the average depth of ground water indicated that there is considerable difference in the water table before WDP and after WDP(Fig.4.16). The depth of water table increased by 25 per cent during the project period, indicating that the watershed development programme could make a positive impact with more ground water recharge.

4.4.16. Distribution of Inputs

The details of inputs distributed in the watershed area are given in Table 4.96. Under the scheme, a total of 1000 kg of cowpea and 20,000 suckers of banana were distributed in the watershed.

4.1.17. Allocation and Utilization of watershed budget

The watershed budget and the various activities included in the watershed programme are outlined in Table 4.97. The project was implemented at an outlay of Rs.43.00 lakhs, of which 35 per cent were spent on management activities. The development activities received 65 per cent of the watershed budget.

The basic activities under the project included soil surveys, mapping works and projectisation. Other basic activities included providing training, establishment and management expenses, research, and innovate research etc. The development activities included conservation measures in the arable and non arable land, improvement of homesteads, livestock development and women specific activities. The drainage line treatment received the maximum allotment under this head (21.60 per cent).

Table 4.96. Distribution of inputs for Beneficiary in *Uppukandam* watershed

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	KAU	Total	KB	Private	KAU	Co-op	Total
Planting materials (no.)	0	0	0	0	0	0	0	0	0	0
Cowpea seeds (Kg)	0	0	0	0	0	1000	0	0	0	1000
Banana suckers (nos.)	0	0	0	0	0	20,000	0	0	0	0
Fertilizer (no:)	0	0	0	0	0	0	0	0	0	0
PP chemicals(ml)	0	0	0	0	0	0	0	0	0	0
Mechanical equipment(no) Tiller	0	0	0	0	0	0	0	0	0	0

Table 4.97. Allocation and Utilization of budget in *Uppukandam* watershed

Sl.No.	Components	Allocation of funds (Rs)	% to total
A	***Management components***	***15,05,000***	***35.00***
B	Development component		
I	Arable land		
	Conservation measures	4,48,950	10.44
	Production system	3,87,000	9.00
	Sub Total	***8,35,950***	***19.44***
II	Non arable land		
	Conservation measures	2,05,502	4.78
	Production system	1,79,000	4.18
	Homestead	43,000	1.00
	Livestock management	2,58,000	6.00
	Women specific activities	2,05,000	4.77
	Sub total for development component	***27,95,000***	***65.00***
	Grand Total	**43, 00,000**	**100.00**

4.4.18. Constraints in the watershed development programme

The major constraints experienced by the sample farmers were identified and presented in Table 4.98. The non-availability of irrigation water was the major constraint encountered. Inadequacy of sanctioned amount, untimely availability of inputs and subsidy from Krishi Bhavan, lack of follow up and insufficient credit support were the other main constraints perceived by the stakeholders. It may be noted that though the watershed community experienced political interference, it was perceived to be at levels not adversely affecting the implementation of the programme, and hence ranked low in the order of importance.

Table 4.98. Constraints in the watershed development programme in *Uppukandam* watershed

Sl.No.	Constraint	Rank
1	Non-availability of irrigation water	1
2	Inadequacy of sanctioned amount	2
3	Untimely availability of inputs and subsidy from Krishi Bhavan	3
4	Lack of supervision and follow-up	4
5	Insufficient credit availability	5
6	Lack of awareness about the beneficial programme	6
7	Lack of technical guidance	7
8	Political interference	8

The following conclusions are made from the above analyses:

- The project was undertaken after a systematic integrated biophysical and socioeconomic survey. The training needs were properly identified, and the watershed components identified in a more need based manner. This could result in a higher level of adoption of soil and water conservation measures. The programme could result in high adoption of soil and water conservation practices in the area. Contour trenching, rain pitting, earthen bunds and centripetal terracing were adopted well by the beneficiary farmers.
- This resulted in a significant increase in water harvesting in the area. On an average, water table increased by 25 per cent, which can be attributed to increased groundwater recharge.
- There was increase in the farm assets of the beneficiary farmers on account of higher adoption of scientific soil and water conservation practices.
- The increased availability of ground water resulted in increased crop productivity. The productivity increase in crops varied from 7 per cent in coffee to 18 per cent in cardamom and arecanut. Coconut registered the highest gain in productivity (22 %).

- Even though the livestock ownership was higher among the beneficiary farmers , the livestock status did not undergo any change during the project period. The cost of livestock rearing declined substantially on account increased fodder availability and reduced time for fodder collection. However, this could not be increased livestock income.
- There was increased labour use in crop production in the post project period. The increase in labour use varied from 6 per cent per ha cultivated in coffee to 30 per cent per ha cultivated in pepper. The maximum change in labour use exhibited by coconut (82 per cent). This was indicative of the positive impact made by the programme in the form of additional employment generation.
- The farm income increased in nominal as well as real terms. There was modest increase in real income growth in cardamom (0.90 %) and pepper (1.73 %) to robust increase in arecanut (14.52 %). It was observed that the higher crop productivity achieved during the project period was partly offset by increased labour use, which was an expensive input considering the wage rates in Kerala. Higher expenses were incurred on material inputs, particularly on manures in the event of improved soil moisture regime.
- There was no apparent impact of the programme on the educational status, cropping pattern or cropping intensity of the beneficiary farmers.
- There was no impact on soil fertility status as measured by the organic matter status.
- There was improvement in green cover in the arable as well as non arable land.
- The impact of the women specific activities, landless people and availability of firewood was minimal. Though the special component on women based activities could not make any quantified impact, their attitude towards soil and water conservation has improved drastically on account of the trainings imparted.
- There was improvement in the drainage facilities in the area. Stabilization of the embankments has helped to arrest further degradation. The quality of the civil works was also satisfactory.
- There was sustainability of conservation measures adopted as evidenced by the maintenance of structures and continued agronomic measures.
- There was reasonable level of participation of the watershed community in project planning and implementation. However, the paradox of non-availability of water continued in the area despite improved ground water status. It is expected that participatory approaches towards benefit sharing can solve this problem.

4.5. ELANAD WATERSHED

4.5.1 Family size

The distribution of respondents based on family size showed that 84 per cent of the beneficiaries had a small family size upto 5 members while 4 per cent had large families with more than 7 members (Table 4.99). All the non-beneficiaries had a family size upto five members.

Table 4.99. Family size of the sample farmers in *Elanad* watershed

Sl.No.	Family size	Beneficiary	Non Beneficiary
1	Less than 5	42 (84)	25 (100)
2	Between6 to 7	6 (12)	0 (0)
3	More than 7	2 (4)	0 (0)
	Total	**50** **(100)**	**25** **(100)**

(Figures in parenthesis indicate percentage to the respective total)

4.5.2. Age

The classification of respondents on the basis of age is shown in Table 4.100. Majority of the beneficiaries belonged to the age group between 35-55 years, while 40 per cent of them were above 55 years of age. On the other hand, 48 per cent of the non beneficiaries belonged to age group between 35-55.

Table 4.100. Age group of the sample farmers in *Elanad* watershed

Sl.No.	Age group (Years)	Beneficiaries	Non beneficiaries
1	Less than 35	0 (0)	3 (12)
2	Between 35-55	30 (60)	12 (48)
3	More than 55	20 (40)	10 (40)
	Total	**50** **(100)**	**25** **(100)**

(Figures in parenthesis indicate percentage to the respective total)

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4.5.3. Educational status

The educational background of the people of the project area is also a factor that influences the implementation of the programmes. The illiteracy and poor resource base can be a hindrance to the adoption of the components of public funded programmes. Table 4.101 revealed that majority of the beneficiaries had secondary education (91.25 per cent) and only two of them were illiterate. Compared to this, nearly 83.59 per cent of the non-beneficiaries had secondary education while 1.36 per cent were illiterates.

Table 4.101. Educational level of the sample farmers in *Elanad* watershed

Sl.No.	Educational level	Beneficiaries	Non beneficiaries
1	Illiterate	2 (0.92)	1 (1.36)
2	SSLC	198 (91.25)	61 (83.59)
3	Graduation	16 (7.37)	10 (13.69)
4	Post graduation	1 (0.46)	1 (1.36)
	Total	**217 (100)**	**73 (100)**

(Figures in parenthesis indicate percentage to the respective total)

4.5.4. Family income

The majority of the beneficiary as well as non beneficiary farmers earned more than Rs.one lakh per annum (Table 4.102). Hardly 16 per cent of the beneficiary farmers belonged

Table 4.102. Annual family income of the sample farmers in *Elanad* watershed

Sl.No.	Family income per annum (Rs)	Respondents	
		Beneficiary	Non-beneficiary
1	Less 50, 000	8 (16.00)	6 (24.00)
2	50, 000-100,000	17 (34.00)	12 (48.00)
3	Above 100, 000	25 (50.00)	7 (28.00)
	Total	**50 (100.00)**	**25 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

to the income group of less than Rs.50,000.

4.5.5 Land use pattern

The watershed development programme could bring about a small change in the pattern of land use for agriculture. (Table 4.103).There was nearly 4.7 per cent increase in

Table 4.103. Land use pattern of the sample farmers in *Elanad* watershed (in ha)

Sl.No	Land use	Beneficiaries		Non-beneficiaries
		Before WDP	After WDP	
1	Agriculture	0.84	0.88	0.86
2	Non agriculture	0.08	0.04	0.07
	Total	**0.92**	**0.92**	**0.93**

the area for agricultural purposes. The increase in agricultural area could be attributed to the conversion of non arable land for cultivation of fodder crops, fodder trees etc.

4.5.6 Cropping pattern

The cropping pattern of the respondent farmers were worked out and presented in Table 4.104. It revealed that paddy was the major crop grown in the area. It occupied nearly 36.36 per cent of the total cropped area of the beneficiary farmers. This was followed by rubber (19.32 per cent), and coconut (18.18 per cent). There was no significant difference in cropping pattern between beneficiary and non beneficiary farmers.

4.5.7. Cropping Intensity of the farmers

The cropping intensity of the respondent farmers are worked out and presented in Table 4.105. It can be noted that the cropping intensity of beneficiary farmers was higher than that of the non beneficiary farmers.

4.5.8. Labour use pattern

The labour use pattern of the beneficiary and non beneficiary farmers are shown in Table 4.106. There is a substantial increase in labour use following the implementation of the project in case of beneficiaries. The labour use increased by 10.34 per cent during this period. The increase in labour use was substantial for pepper (15.96 per cent), arecanut (16.88 per cent), rubber (20.00 per cent), and coconut (20.00 per cent). However, the average

Table 4.104. Cropping pattern of the sample farmers in *Elanad* watershed (in ha)

Sl.No.	Crop	Beneficiary	Non Beneficiary
1	Paddy	0.32 (36.36)	0.34 (39.53)
2	Coconut	0.16 (18.18)	0.18 (20.93)
3	Rubber	0.17 (19.32)	0.15 (17.44)
4	Banana	0.06 (6.82)	0.03 (3.49)
5	Pepper	0.04 (4.55)	0.06 (6.98)
6	Arecanut	0.05 (5.68)	0.06 (6.98)
7	Others	0.08 (9.09)	0.04 (4.65)
	Total	**0.88 (100)**	**0.86 (100)**

(Figures in parentheses indicate percentage to the respective totals)

Table 4.105. Cropping intensity of the sample farmers in *Elanad* watershed

Sl.No.	Category	Gross sown area (ha)	Net sown area (ha)	Cropping intensity (%)
1	Beneficiary	0.88	0.69	127.5
2	Non-beneficiary	0.86	0.74	116.2

labour intensity for the non beneficiaries was higher than that of beneficiary farmers. This was caused by the higher per hectare Labour use by the non beneficiary farmers in paddy and banana cultivation.

4.5.9. Productivity of major crops

The productivity of the major crops grown in the watershed area is depicted in Table 4.107. It can be noted that the productivity of all major crops in the area underwent significant improvements(Fig. 4.17). It varied from 13.54 per cent in rubber to 18-21 per cent increase

Table 4.106. Labour use pattern of the sample farmers in *Elanad* watershed (labour days per ha)

Sl.No.	Crops	Beneficiary			Non beneficiary	Per centage change over control
		Before WDP	After WDP	Percentage change over time		
1	Coconut	70	84	20.00	81	3.70
2	Arecanut	77	90	16.88	89	1.12
3	Paddy	156	160	2.56	177	-9.60
4	Banana	166	167	0.67	183	-8.74
5	Pepper	94	109	15.96	104	4.81
6	Rubber	130	156	20.00	154	1.30
	Mean	**116**	**128**	**10.34**	**131**	**-2.29**

in pepper, banana and arecanut. The highest increase in productivity was noted in the case of coconut (26.92 per cent). Thus, it is evident that the project could achieve the productivity improvements envisaged in the watershed development programme.

Table 4.107. Productivity of major crops in *Elanad* watershed

Sl.No.	Crops	Beneficiary			Non beneficiary	Percentage change over control
		Before WDP	After WDP	Percentage change over time		
1	Paddy (Kg/ha)	3250	3829	17.82	3749	2.13
2	Coconut (nuts /palm)	26	33	26.92	30	10.00
3	Arecanut (nuts /palm)	96	116	20.83	109	6.42
4	Rubber (Kg/ha)	901	1023	13.54	961	6.45
5	Banana (Kg/ha)	5132	6120	19.25	5960	2.68
6	Pepper (Kg/ha)	183	216	18.03	209	3.35

4.5.10. Crop wise farm expenses

The cost of cultivation of major crops grown in the area is estimated on nominal as well as real terms on per hectare basis and presented in Table 4.108, 4.109,4.110,4.111,4.112, and 4.113. All the comparisons are made in real terms.

Table 4.108. Input wise farm expenses for paddy crop in *Elanad* watershed (Rs/ha)

Sl. No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	17200	19,920	17,550	19480	17,162
2	Seeds	834	952	839	950	837
3	Manures	320	450	396	300	264
4	Fertilizers	458	564	497	562	495
5	PP chemicals	300	310	273	350	308
	Total	**19,112**	**22,196**	**19,555**	**21,642**	**19,066**

Table 4.109. Input wise farm expenses for coconut crop in *Elanad* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	7700	9240	8140	8900	7841
2	Seeds	0	0	0	0	0
3	Manures	820	1256	1107	864	761
4	Fertilizers	662	780	687	984	867
5	PP chemicals	0	0	0	0	0
	Total	**9182**	**11, 276**	**9934**	**10,748**	**9469**

Table 4.110. Input wise farm expenses for arecanut crop in *Elanad* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	8450	9930	8748	9780	8616
2	Seeds	0	0	0	0	0
3	Manures	1540	1825	1608	1560	1374
4	Fertilizers	415	496	437	436	384
5	PP chemicals	0	0	0	0	0
	Total	**10,405**	**12,251**	**10,793**	**11,776**	**10,374**

It revealed that the cost of cultivation of paddy, arecanut and rubber did not undergo any significant change during the project period. But, there was a visible change in the cost of cultivation of crops like coconut, banana, and pepper.

Table 4.111. Input wise farm expenses for banana crop in *Elanad* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	18,310	20,820	18,342	20,110	17,717
2	Seeds	2356	3125	2753	3026	2666
3	Manures	7650	8930	7867	8200	7224
4	Fertilizers	3910	4752	4187	5630	4960
5	PP chemicals	250	290	255	250	220
	Total	**32,476**	**37,917**	**33,404**	**37,216**	**32,787**

Table 4.112. Input wise farm expenses for pepper crop in *Elanad* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,330	11,970	10,546	11,450	10,087
2	Seeds	0	0	0	0	0
3	Manures	2900	3250	2863	3650	3216
4	Fertilizers	420	510	449	420	370
5	PP chemicals	230	310	273	350	308
	Total	**13,880**	**16,040**	**14,131**	**15,870**	**13,981**

Input wise analysis of farm expenses revealed that human labour was the major cost item in all the crops. Expenses incurred on manures were the second important item of expenditure. The increase in human labour was more evident in coconut, arecanut and

Table 4.113. Input wise farm expenses for rubber crop in *Elanad* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	14,300	17,180	15,136	16,920	14,907
2	Seeds	0	0	0	0	0
3	Manures	2530	2680	2361	2530	2229
4	Fertilizers	800	810	714	950	837
5	PP chemicals	2200	1850	1630	2100	1850
	Total	**19,830**	**22,520**	**19,841**	**22,500**	**19,823**

rubber. There was a discernible increase in the outlay on manures and chemical fertilizers once the sioil moisture regime improved. This was more noticeable in coconut, arecanut, and banana.

4.5.11. Income pattern

The farm income of the farmers in the project area and non project area as depicted in Table 4.114.

Table 4.114. Income pattern of the sample farmers in *Elanad* watershed (Rs/ha)

Sl. No.	Crops	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Paddy	19,500	22,974	20,240	3.79	22,494	19,817
2	Coconut	16,224	20,592	18,142	11.82	18,720	16,492
3	Arecanut	16,320	19,720	17,373	6.45	18,530	16,325
4	Rubber	30,634	34,782	30,643	0.03	32,674	28,786
5	Banana	46,188	55,080	48,525	5.06	53,640	47,257
6	Pepper	14,640	17,280	15,224	3.99	16,720	14,730
	Mean	**23, 918**	**28, 405**	**25, 025**	**4.63**	**27, 130**	**23, 901**

On an average, the farm income increased by 4.63 per cent during the project period. A crop wise analysis of the farm income per hectare revealed that the increase was modest in paddy, rubber, pepper and banana(Fig.4.18). It was highest in coconut (11.82 %).

4.5.12. Livestock Status

The watershed programmme had given thrust to livestock management components. It could be seen from Table 4.115 that cow, goat, pig and poultry were the common livestock components in the area. About 24 per cent of the beneficiaries owned cow whereas 30 per cent reared goat. Poultry rearing was undertaken by 42.11 per cent of the beneficiaries the livestock population on the beneficiary farms were higher than that of non beneficiary farmers.

The expenses incurred by the beneficiaries and non beneficiaries declined during the project period. This was on account of reduction in expenditure on human labour,

Table 4.115. Livestock status of the sample farmers in *Elanad* watershed (No. / farm)

Sl.No.	Type of livestock	Beneficiaries	Non beneficiaries
1	Cow	18 (23.68)	11 (23.40)
2	Goat	23 (30.26)	13 (27.66)
3	Pig	3 (3.95)	2 (4.26)
4	Poultry	32 (42.11)	21 (44.68)
	Total	**76 (100)**	**47 (100)**

(Figures in parentheses indicate percentage to the respective totals)

Table 4.116. Cost of livestock production in *Elanad* watershed .(Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At current Prices (2003-04)	At constant Prices (1998-99)
			At current Prices (2003-04)	At constant Prices (1998-99)		
1	Concentrate	3450	3300	2907	3250	2863
2	Dry fodder	1250	900	793	1100	969
3	Labour charge	5300	5330	5242	5600	4934
4	Miscellaneous expenses	950	875	771	1050	925
	Total	**10, 950**	**11, 125**	**9801**	**11, 000**	**9691**

concentrate feed and dry fodder. Cultivation of fodder crops and planting of fodder trees in the farm boundaries resulted in abundant green fodder availability. This helped in reducing expenses on fodder and its collection.

Table 4.117. Livestock Income in *Elanad* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Milk	11,200	13,800	12,158	13,100	11,541
2	Dung	1750	1850	1630	1750	1542
	Total	**12, 950**	**15, 650**	**13, 788**	**14, 850**	**13, 083**

It was observed that the livestock income during the project period increased considerably during the project period. The livestock of the beneficiary farmers was higher than that of non-beneficiaries.

4.5.13. Soil and water conservation measures

The watershed area lies in a range of physiographic classes and the slope also ranges from gently sloping to steep areas. Sedimentation, transportation and rapid nutrient depletion from surface soil were the fundamental problem in the watershed. The watershed development programmes are addressed mainly to areas suffering from soil degradation and moisture stress.

Table 4.118. Adoption of soil and water conservation measures in *Elanad* watershed (No: of the respondents)

Sl.No.	Category	Beneficiaries	Non Beneficiaries
1	Contour bunding	15 (30)	11 (44)
2	Trenching	4 (8)	6 (24)
3	Live fencing	24 (48)	12 (48)
4	Rain pit	15 (30)	12 (48)
5	Bunds	20 (40)	8 (32)
6	Terrace	36 (72)	16 (64)
7	Centripetal terrace	18 (36)	11 (44)
8	Mulching	38 (76)	23 (92)
9	Earthen bunds	34 (68)	18 (72)

(Figures in parentheses indicate percentage to the respective totals)

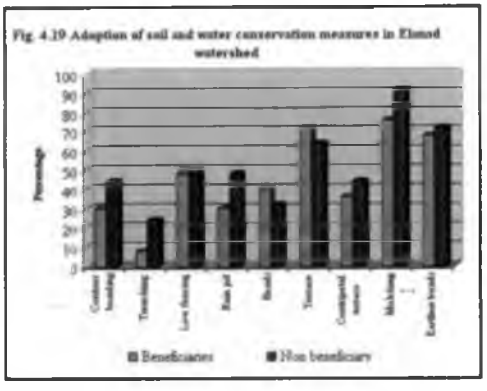


Fig. 4.19 Adoption of soil and water conservation measures in Elanad watershed
Percentage
Beneficiaries
Non beneficiary

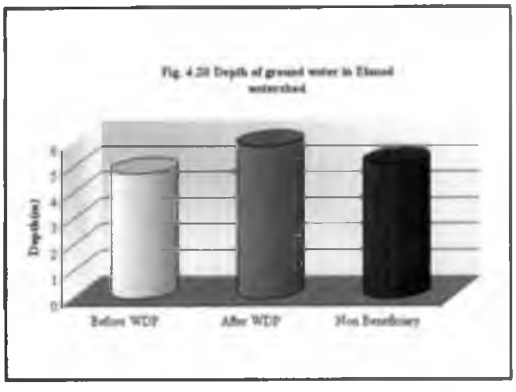


Fig. 4.20 Depth of ground water in Elanad watershed
Depth (m)
Before WDP
After WDP
Non Beneficiary

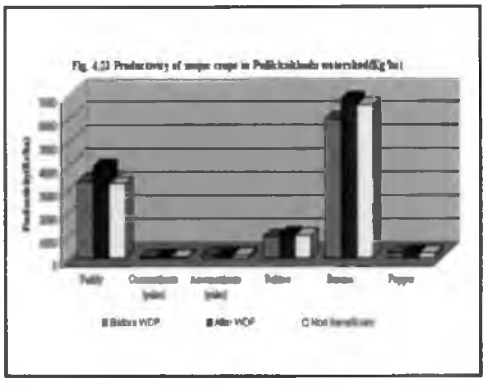


Fig. 4.21 Productivity of major crops in Pullickalthodu watershed(Kg/ha)
Paddy
Banana
Pepper
Before WDP
After WDP

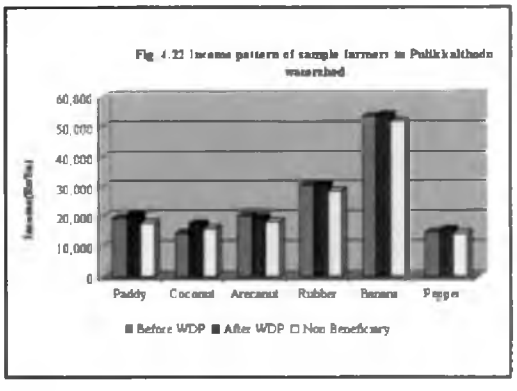


Fig. 4.22 Income pattern of sample farmers in Pullickalthodu watershed
60,000
50,000
40,000
30,000
20,000
10,000
0
Paddy
Coconut
Arecanut
Rubber
Banana
Pepper
Before WDP
After WDP
Non Beneficiary

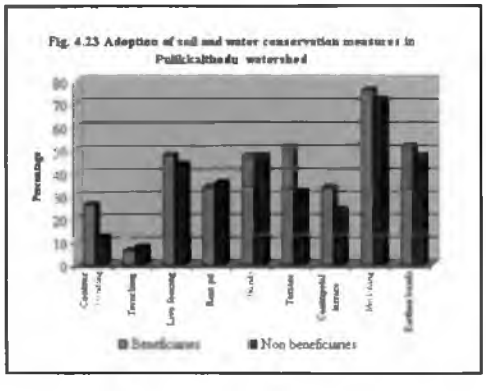


Fig. 4.23 Adoption of soil and water conservation measures in Pullickalthodu watershed
Percentage
Beneficiaries
Non beneficiaries

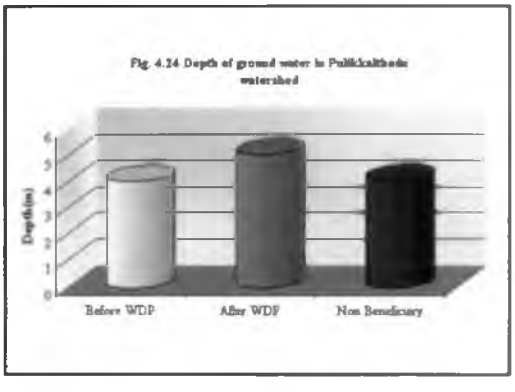


Fig. 4.24 Depth of ground water in Pullickalthodu watershed
Depth (m)
Before WDP
After WDP
Non Beneficiary

It could be observed from Table 4.118 that the practice of mulching, contour bunding, earthen bunds, and rain pitting were the more adopted practices (Plate 7and Fig.4.19). The adoption by non beneficiaries was only nominal. It was limited to the adoption of mulching, construction of bunds and fencing with live trees.

4.5.14. Organic matter content of the soil

The organic matter content of the soil was analyzed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 1.3 to 6.1 percent in the beneficiary sample with a mean of 3.0. In the control plot the range was from 1.5to 3.5 per cent and the mean was 2. The average content of organic matter in the soil was higher for the beneficiaries when compare to the non beneficiaries. The implementation of the watershed programme could be a major reason for the higher level of organic matter content in the soil of beneficiary farmers.

4.5.15. Ground water status

The details of assistance provided for the renovation of wells and ponds are given in Table 4.119. Out of the 50 beneficiaries, 43 had owned wells and 18 had ponds in their households. Following the implementation of watershed programme, 13 of the beneficiaries had availed assistance for the renovation of wells, while 5 farmers received assistance for the renovation of ponds.

Table 4.119. Assistance for rain water harvesting structures in *Elanad* watershed (Number)

Sl. No.	Respondents	Well	Pond
1	Beneficiaries	43 (13)	18 (5)
2	Non Beneficiaries	19 (0)	4 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

A comparison of the average depth of ground water indicated that there was 21.78 per cent increase in the groundwater level in the wells of beneficiary farmers after the implementation of the programme (Table 4.120 and Fig.4.20). The significant rise in the water levels in the wells of beneficiaries have indicated a positive impact on the moisture regime.

4.5.16 Distribution of inputs for Beneficiary

The details of various inputs distributed in the watershed area are shown in Table 4.121. The planting materials were the only type of inputs provided. No fertilizer or plant protection kits or implements were distributed.

Table 4.120. Depth of Ground water in *Elanad* watershed (in meters)

Sl.No.	Beneficiary	Before WDP	After WDP	% increase
a	Lowest	0.52	0.61	17.30
b	Highest	9.12	11.12	21.92
c.	Average	4.82	5.87	21.78
	Non Beneficiary			
a	Lowest	-	0.55	-
b	Highest	-	9.80	-
c.	Average	-	5.18	13.43

Table 4.121. Distribution of inputs for Beneficiary in *Elanad* watershed

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	KAU	co-op	Total	KB	Private	KAU	Co-op	Total
Planting materials (number)	0	0	0	0	0	4114	-	-	-	4114
Fertilizer (no:)	0	0	0	0	0	NA	NA	NA	NA	NA
PPchemicals (ml)	0	0	0	0	0	0	0	0	0	0
Mechanical equipment Tiller (number)	0	0	0	0	0	0	0	0	0	0

4.5.17. Allocation and Utilization of budget in *Elanad* watershed

The project was implemented at a financial outlay of Rs. 35.98 lakhs, out of which 3.63 was allotted for the management component and 96.37 per cent for the development component. The maximum share was received for conservation measures on the arable land (63.69). Drainage line treatment received 17.61 per cent of the budget for non arable land (Table 4.122).

Table 4.122. Allocation and Utilization of watershed budget in *Elanad*

Sl.No.	Components	Allocation of funds (Rs)	Percentage to total
A	***Management components***	***1,30,755***	***3.63***
B	Development component		
I	Arable land		
	Conservation measures	22,91,374	63.69
	Production system	4,39,088	12.20
II	Non arable land		
	Conservation measures	0	0
	Production system	1,02,789	2.86
	Drainage line treatment	6,33,681	17.61
	Livestock management	0	0
	Sub total for development component	***34,66,932***	***96.37***
	Grand Total	**35,97,687**	**100.00**

Research and innovative support activities did not receive any coverage in the project. There was no provision for homestead gardens, and household production system in spite of the fact that home garden agriculture was a predominant production system in the area. Similarly, husk trenching did not receive any importance even though coconut was a major crop in the area. Fire wood availability, women based activities and programmes for the landless households were totally missing in the project outlay.

4.5.18. Constraints in the watershed development programme

The major constraints experienced by the sample farmers were identified while conducting the survey and presented in Table 4.123. The non-availability of irrigation water, untimely availability of inputs and subsidy from *Krishi Bhavan*, inadequacy of sanctioned amount, lack of awareness about the beneficial programme, lack of supervision and follow-up, and lack of technical guidance were the major constraints perceived by the beneficiaries. Many respondents reported political interference as a constraint, but they assigned lower importance to it as a factor limiting the programme.

The following conclusions are drawn from the above analyses

- The watershed area lies in a range of physiographic classes and the slope also ranges from gently sloping to steep areas. Sedimentation, transportation and rapid nutrient depletion from surface soil were the fundamental problem in the watershed. The

Table 4.123. Constraints in the watershed development programme in *Elanad* watershed

Sl.No.	Constraint	Rank
1	Non availability of irrigation water	1
2	Untimely availability of inputs and subsidy from Krishi Bhavan	2
3	Lack of awareness about the beneficial programme	3
4	Lack of supervision and follow-up	4
5	Lack of technical guidance	5
6	Political interference	6
7	Inadequacy of sanctioned amount	7
8	Insufficient credit availability	8

positive impact of the watershed programme is reflected in the increase in the number of beneficiaries adopting the soil conservation measures like contour bunding, construction of earthen bunds, terracing, and mulching.

- The water harvesting techniques like rain pitting, digging and renovation of wells were instrumental in raising the depth of water table in the watershed by around 20 percent with the result that even during the dry months water was available while water scarcity was a serious problem in these areas before the project when wells start drying up from February onwards. There was significant rise in the water levels of the beneficiaries indicating a positive impact on the moisture regime and groundwater recharge.

- The watershed development programme has brought about little changes in the pattern of land use for agriculture. There was nearly 4.7 per cent increase in the area used for agricultural purposes by the beneficiaries. The increase in agricultural area could be attributed to the conversion of non arable land for cultivation of fodder crops, fodder trees etc.

- There has been an increase in employment generation on account of the increase in labour use in agriculture related activities during the post project period. The increase in labour use per hectare was substantial for coconut, rubber, arecanut and pepper.

- The increase in crop productivity as a result of various factors like increased human labour use, increase in manure application and increased moisture availability have been translated into higher farm income in nominal as well as real terms. The average farm income increased to the tune of 4.63 per cent in real terms.

- Watershed Development Programmes have brought out certain changes in livestock production systems using increased quantity of fodder, improvement of livestock management systems etc. There was an increase in the livestock population during the post project period. The livestock income also recorded an increase in real terms during this period.

- There was increase in green fodder availability among beneficiary farmers. Cultivation of fodder crops as a part of crop farming, raising of fodder trees in the farm fences, have increased green fodder availability.

- The project could not make any significant impact on cropping pattern and cropping intensity in the watershed area.

- There were no efforts to have conservation measures in non-arable land. The success of watershed development crucially depends on the holistic approach, whereby arable and non arable land receives priority in treatments.

- The drainage treatment was effective - but the sedimentation rate could not be reduced due to non treated non-arable and arable lands in the watershed (plates 8,9 and 10).

- The sustainability of conservation measures were low. There was lack of sincere and systematic efforts to maintain the soil conservation measures (lates (Plates 11,12,13 and 14)

- The project could improve the soil fertility status as evidenced though the soil tests data.

- The project failed to address women based activities, landless households and firewood availability. However, the women folk benefited indirectly through livestock related activities because it was them who were involved in livestock rearing.

- There was reasonable level of people's participation in the project planning and implementation in the project under reference.

- The non-availability of irrigation water, untimely availability of inputs and subsidy from *Krishi Bhavan*, inadequacy of sanctioned amount, lack of awareness about the beneficial programme, lack of supervision and follow-up, and lack of technical guidance were the major constraints perceived by the beneficiaries. Many respondents reported political interference as a constraint, but they assigned lower importance to it as a factor limiting the programme.

4.6. PULIKKALTHODU WATERSHED

4.6.1. Family size

The distribution of respondents based on family size as shown in Table 4.124 indicated that 70 per cent of the beneficiaries had a family size of less than 5 members, and 16 per cent had more than 7 members in the family. In the non beneficiaries group, 88 per cent had a family size of less than 5 members and 12 per cent of the families had family members between 6-7 members.

Table 4.124. Family size of the sample farmers in *Pulikkalthodu* watershed

Sl.No.	Family size	Beneficiaries	Non beneficiaries
1	Less than 5	35 (70)	22 (88)
2	Between6-7	7 (14)	3 (12)
3	Above 7	8 (16)	0 (0)
	Total	**50 (100)**	**25 (100)**

(Figures in parentheses indicate percentage to the respective totals)

4.6.2. Age

The classification of respondents on the basis of age as given in Table 4.125 showed that 44 per cent of the beneficiaries belonged to the age group between 35-55 years and 54 per cent of the beneficiaries were above the age of 55 years. Majority of the non beneficiaries belonged to age group between 35-55 years (68 per cent) and only 28 per cent were above 55 years of age. The table revealed that there is adequate working force was available in the area to carry out the project-related works.

Table 4.125. Age group of the sample farmers in *Pulikkalthodu* watershed

Sl.No.	Age group (Years)	Beneficiaries	Non beneficiaries
1	Less than 35	1(2)	1(4)
2	Between 35-55	22(44)	17(68)
3	Above 55	27(54)	7(28)
	Total	**50(100)**	**25(100)**

Plate 7. Increased water harvesting in Elanad

Plate 8. Untreated non arable land in Elanad

Plate 9. Untreated arable land in Elanad

Plate 10. Stream bank sedimentation in Elanad

Plate 11. Neglected rain pit in Elanad

Plate 12. Neglected trench in Elanad

4.6.3. Educational status

The results as shown in Table 4.126 revealed that 66 per cent of the beneficiaries had secondary school education, while nearly 15 per cent of them were illiterates. 75 per cent of the non beneficiaries had secondary school education, while 21 per cent of them were illiterates. Nearly 18 per cent of the beneficiaries were graduates.

Table 4.126. Educational level of the sample farmers in *Pulikkalthodu* watershed

Sl.No.	Educational level	Beneficiaries	Non beneficiaries
1	Illiterate	38 (15)	25 (21)
2	SSLC	163 (66)	88 (75)
3	Graduation	43 (18)	4 (4)
4	Post graduation	2 (1)	0 (0)
	Total	**246 (100)**	**117 (100)**

Figures in parentheses indicate percentage to the respective totals)

The higher proportion of illiterates among the beneficiaries points towards the need for training and orientation on watershed components and programmes.

4.6.4. Family income

The distribution of respondents as given in Table 4.127 revealed that around 44 percent belonged to the income group between Rs 50000 to Rs. 100000 and 38 per cent belonged to the income group of greater than 1,00,000. In the case of non beneficiaries 48 per cent belonged to the income group between Rs 50000 to Rs. 100000 beneficiaries and 14 per cent farmers belonged to more than one lakh income group

Table 4.127. Annual family income of the farmers in *Pulikkalthodu* watershed

Sl.No.	Family income per annum (Rs)	Respondents	
		Beneficiary	Non beneficiary
1	Less 50, 000	9 (18.00)	7 (28.00)
2	50, 000-100,000	22 (44.00)	12 (48.00)
3	Greater than 100, 000	19 (38.00)	6 (14.00)
4	Total	50 (100.00)	25 (100.00)

(Figures in parentheses indicate percentage to the respective totals)

4.6.5 Land use pattern

The watershed development programme has brought about certain marginal changes in the pattern of land use for agriculture. Table 4.128 indicated that there was nearly 3.8 per cent increase in the area used for agricultural purposes by the beneficiaries. The land utilization pattern among the non beneficiaries showed similar pattern.

Table 4.128. Land use pattern of the sample farmers in *Pulikkalthodu* watershed (ha)

Sl.No.	Land use	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Agriculture	0.79	0.82	0.79
2	Non agriculture	0.08	0.05	0.06
	Total	**0.87**	**0.87**	**0.85**

4.6.6. Cropping pattern

An analysis of the cropping pattern of the respondents as shown in Table 4.129 revealed that rice was the major crop grown in the area, occupying nearly 29.27 and 32.91 percentages of the total cropped area of the beneficiary as well as non beneficiary farmers.

Table 4. 129. Cropping pattern of the sample farmers in *Pulikkalthodu* watershed (ha)

Sl.No	Crop	Beneficiaries	Non-beneficiaries
1	Rice	0.24 (29.27)	0.26 (32.91)
2	Coconut	0.22 (26.83)	0.19 (24.05)
3	Rubber	0.23 (28.05)	0.20 (25.32)
4	Banana	0.07 (8.54)	0.03 (3.79)
5	Pepper	0.02 (2.44)	0.05 (6.33)
6	Arecanut	0.03 (3.66)	0.03 (3.79)
7	Others	0.01 (1.23)	0.03 (3.79)
	Total	**0.82 (100)**	**0.79 (100)**

(Figures in parentheses indicate percentage to the respective totals)

This was followed by rubber (28.05 per cent), coconut (26.83 per cent) and banana (8.54 per cent) for beneficiaries. There was no substantial difference in the cropping pattern of beneficiaries and non beneficiaries.

4.6.7. Cropping Intensity of the farmers

The cropping intensity of the respondent farmers are worked out and presented in Table 4.130. It can be noted that the cropping intensity was low, and there was no significant difference in the cropping intensity of beneficiary and non beneficiary farmers.

Table 4.130. Cropping intensity of the sample farmers in *Pulikkalthodu* watershed

Sl.No.	Category	Gross sown area (ha/farm.)	Net sown area (ha/farm.)	Cropping intensity (%)
1	Beneficiary	2.35	2.14	109.8
2	Non-beneficiary	2.54	2.25	112.8

4.6.8. Labour use pattern

The labour use pattern, as shown in Table 4.131, showed an increase by 16 per cent in following the implementation of the project. The increase in labour use per hectare was substantial for banana (14.84), pepper (15.96), rubber (15.83), arecanut (17.50) and coconut (20.24).

Table 4.131. Labour use pattern of the sample farmers in *Pulikkalthodu* watershed (labour days per ha)

Sl.No.	Crops	Beneficiary			Non beneficiary	Percentage change over control
		Before WDP	After WDP	Percentage change over time		
1	Paddy	100	116	16.00	108	7.41
2	Coconut	84	101	20.24	99	2.02
3	Arecanut	80	94	17.50	92	2.17
4	Banana	155	178	14.84	174	2.30
5	Pepper	94	109	15.96	104	4.81
6	Rubber	120	139	15.83	135	2.96
	Mean	**106**	**123**	**16.04**	**119**	**3.36**

4.6.9. Productivity of major crops

The productivity of major crops in the project area before and after investment and in control group is presented in Table 4.132.

Table 4.132. Productivity of major crops in *Pulikkalthodu* watershed

Sl. No.	Crops	Beneficiary			Non beneficiary	% change over control
		Before WDP	After WDP	% change over time		
1	Paddy (Kg/ha)	3285	3950	20.24	3200	23.44
2	Coconut (nuts /palm)	23	32	39.13	29	10.34
3	Arecanut (nuts /palm)	118	131	11.02	123	6.50
4	Rubber (Kg/ha)	902	1031	14.30	956	7.85
5	Banana (Kg/ha)	5952	6820	14.58	6550	4.12
6	Pepper (Kg/ha)	185	223	20.54	204	9.13

The productivity of all the major crops in the watershed area showed increase. There was modest increase in yield from 11 to 15 per cent in arecanut, rubber and banana and 20 per cent in paddy and pepper(Fig.4.21). The maximum increase was shown by coconut (39.13 per cent).

4.1.10 Crop wise farm expenses

The cost of cultivation was estimated on nominal as well as real terms and presented in Tables 4.133, 4.134, 4.135, 4.136, 4.137 and 4.138. It may be noted that all the comparisons are made in real terms. It showed that coconut, paddy ,banana and rubber reported substantial change in cultivation expenses during the project period.

Increase in expenses in human labour was more pronounced in paddy, coconut, arecanut, banana, pepper and rubber. Increased expenses in material inputs like manures and fertilizers were observed for coconut, arecanut and pepper. Increased expenditure on manures due to increased moisture availability was noted in paddy, banana and rubber.

Table 4.133. Input wise farm expenses for paddy crop in *Pulikkathodu* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,950	12,810	11,286	11,930	10,510
2	Seeds	2653	3423	3016	3263	2874
3	Manures	520	680	599	500	440
4	Fertilizers	358	345	304	362	319
5	PP chemicals	356	342	301	372	327
	Total	**14, 837**	**17, 600**	**15, 506**	**16, 427**	**14, 470**

4.6.11 Income pattern

The farm income of the farmers in the project area and non-project area as depicted in Table 4.139. It showed that the income per hectare from all the major crops grown in the area increased in real terms except arecanut. The income increased on an average by 3.66

Table 4.134. Input wise farm expenses for coconut crop in *Pulikkathodu* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	9250	11,060	9744	10,900	9603
2	Seeds	0	0	0	0	0
3	Manures	920	1356	1195	964	849
4	Fertilizers	562	650	573	684	603
5	PP chemicals	0	0	0	0	0
	Total	**10,732**	**13,066**	**11,512**	**12,548**	**11,055**

Table 4.135. Input wise farm expenses for arecanut crop in *Pulikkathodu* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	8800	10,350	9118	100,80	8880
2	Seeds	0	0	0	0	0
3	Manures	1720	1860	1639	1560	1374
4	Fertilizers	315	376	331	436	384
5	PP chemicals	0	0	0	0	0
	Total	**10,835**	**12,586**	**11,088**	**12,076**	**10,638**

per cent. The increase was modest in paddy, rubber, banana, and pepper, but more pronounced for coconut(Fig.4.22). The gain in productivity in arecanut could not be converted into monetary gains, mainly on account of the increased labour expenses in the post project period.

Table 4.136. Input wise farm expenses for banana crop in *Pulikkathodu* watershed(Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	17,030	19,560	17,232	19,110	16,836
2	Seeds	2610	3260	2872	3320	2925
3	Manures	8870	10,500	9251	10,100	8898
4	Fertilizers	3210	3100	2731	2980	2625
5	PP chemicals	200	200	176	200	176
	Total	**31,920**	**36,620**	**32,262**	**35,710**	**31,460**

Table 4.137. Input wise farm expenses for pepper crop in *Pulikkathodu* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	10,330	11,970	10,546	11,450	10,087
2	Seeds	0	0	0	0	0
3	Manures	3250	3950	3480	3550	3128
4	Fertilizers	330	410	361	320	282
5	PP chemicals	210	210	185	250	220
	Total	**14,120**	**16,540**	**14,572**	**15,570**	**13,717**

4.6.12 Livestock Status

The watershed development programme has given considerable importance to livestock development programmes in the area. It could be seen from Table 4.140 that rearing of poultry, cow, goat and pig were undertaken by the respondents. 48 per cent of the

Table 4.138. Input wise farm expenses for rubber crop in *Pulikkathodu* watershed(Rs/ha)

(Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	13,240	15,290	13,470	14,820	13,056
2	Seeds	0	0	0	0	0
3	Manures	3330	3860	3401	2430	2141
4	Fertilizers	600	510	449	850	749
5	PP chemicals	1350	1450	1277	1550	1366
	Total	**18,520**	**21,110**	**18,597**	**19,650**	**17,312**

Table 4.139. Income pattern of the sample farmers in *Pulikkalthodu* watershed (Rs/ha)

Sl.No.	Crops	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	% change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Paddy	19,710	23,700	20,880	5.94	20,400	17,972
2	Coconut	14,352	19,968	17,592	22.58	18,096	15,943
3	Arecanut	20,060	22,270	19,620	-2.19	20,910	18,422
4	Rubber	30,668	35,054	30,883	0.70	32,504	28,636
5	Banana	53,568	61,380	54,076	0.95	58,950	51,935
6	Pepper	14,800	17,840	15,717	6.20	16,320	14,378
	Mean	**25, 526**	**30, 035**	**26, 461**	**3.66**	**27, 863**	**24, 548**

beneficiaries owned cow and 56 per cent reared goat. Poultry rearing was undertaken by 84 per cent of the beneficiaries while 18 per cent had piggery units.

Table 4.140. Livestock status of the sample farmers in *Pulikkalthodu* watershed (No. / farm)

Sl.No.	Category	Beneficiaries	Non beneficiaries
1	Cow	24(48)	9(36)
2	Goat	28(56)	8(32)
3	Pig	9(18)	2(8)
4	Poultry	42(84)	22(88)

(Figures in parentheses indicate percentage to the respective totals)

Table 4.141showed that the cost of livestock rearing declined considerably during the project period. There was decline in the cost of concentrate, dry fodder and labour charges.

The income from milk and dung are presented in Table 4.142. It is evident that there has been a decline in the income earned by the beneficiaries as compared to non beneficiaries in real terms.

Table 4.141. Cost of livestock production in *Pulikkalthodu* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Concentrate	3608	3326	2930	3723	3280
2	Dry fodder	1028	925	815	1300	1145
3	Labour charge	5200	5300	4669	5260	4634
4	Miscellaneous expenses	800	825	727	1050	925
	Total	**10, 636**	**10, 376**	**9141**	**11, 333**	**9984**

Table 4. 142. Livestock Income in *Pulikkalthodu* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Milk	12,550	13,820	12,175	13,050	11,497
2	Dung	1650	1800	1586	1600	1410
	Total	**14, 200**	**15, 620**	**13, 761**	**14, 650**	**12, 907**

4.6.13 Soil and water conservation

Most of the areas in the watershed experienced shortage of drinking water during the summer months. Most of the streams are left unattended. Absence of scientific crop management and water management has caused poor infiltration and poor production. The water and soil conservation measures were implemented taking these factors into consideration. There was general improvement in the knowledge and practicing of soil conservation in the watershed areas. The practice of mulching was widely prevalent among

the beneficiaries, as nearly 76 per cent of them have adopted this measure. Terracing of lands to enhance water table along with earthen bunds was noted among 52 per cent of the beneficiaries. Construction of rain pits was undertaken by 34 per cent of the beneficiaries (Table 4.143). As against the beneficiaries the performance of the non beneficiaries was only nominal and the widely adopted measures were mulching, construction of bunds and fencing with live trees (Fig.4.23).

Table 4.143. Adoption of soil and water conservation measures in *Pulikkalthodu* watershed (no: of the respondents)

Sl.No.	Category	Beneficiaries	Non Beneficiaries
1	Contour bunding	13 (26)	3 (12)
2	Trenching	3 (6)	2 (8)
3	Live fencing	24 (48)	11 (44)
4	Rain pit	17 (34)	9 (36)
5	Bunds	24 (48)	12 (48)
6	Terrace	26 (52)	8 (32)
7	Centripetal terrace	17 (34)	6 (24)
8	Mulching	38 (76)	18 (72)
9	Earthen bunds	26 (52)	12 (48)

(Figures in parentheses indicate percentage to the respective totals)

4.6.14 Organic matter content of the soil

The organic matter content of the soil was analyzed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 2.6 to 4.7 percent in the beneficiary sample, with a mean value of 3.7. In the control plots, the range of values was from 1.1 to 1.7 per cent, with a mean value of 1.4. The average content of organic matter in the soil was higher for the beneficiaries when compared to the non beneficiaries. The difference in the organic matter content could be attributed to various factors and the implementation of the watershed programme alone could not be the prior reason for this variations.

4.6.15 Ground water status

Table 4.144 is based on the number of wells owned by the beneficiaries and non-beneficiaries. Out of the 50 beneficiaries, 48 of them owned wells and 13 had ponds in their households. Following the implementation of watershed programme, 10 of these beneficiaries had availed the benefits provided for renovation the wells and two of them received the benefits for renovating the ponds.

Table 4.144. Assistance for rain water harvesting structures in *Pulikkalthodu* watershed (Number)

Sl.No.	Respondents	Well	Ponds
1	Beneficiaries	48 (10)	13 (2)
2	Non Beneficiaries	23 (0)	16 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

The average depth of ground water is shown in Table 4.145. It indicated there is a significant difference in the average depth of groundwater before WDP and after WDP on the one hand; and between the beneficiaries and non beneficiaries sample on the other hand (Fig.4.24). The watershed programme has brought about an increase by nearly 25 per cent in the groundwater level, suggesting positive impact of the programme on groundwater recharge.

Table 4.145. Depth of Ground water in *Pulikkalthodu* watershed (in meters)

Sl.No.	Beneficiary	Before WDP	After WDP	Percentage increase
a	Lowest	0.39	0.43	10.26
b	Highest	7.78	9.76	25.44
c.	Average	4.09	5.10	24.69
	Non Beneficiary			
a	Lowest	-	0.37	-
b	Highest	-	7.90	-
c.	Average	-	4.14	23.34

4.6.16 Distribution of inputs for Beneficiary

The seedlings of coconut (1590 nos.), and medicinal plants (1100 nos.) were distributed in the watershed. No other inputs were disbursed under the programme in the watershed (Table 4.146).

Table 4.146. Distribution of inputs for Beneficiary in *Pulikkalthodu* watershed

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	KAU	Total	KB	Private	KAU	Co-op	Total
Planting materials (number)	0	0	0	0	0	2690	0	0	0	2690
Coconut	0	0	0	0	0	1590	0	0	0	0
Medicinal plants	0	0	0	0	0	1100	0	0	0	0
Fertilizer (no:)	0	0	0	0	0	0	0	0	0	0
PPchemicals (ml)	0	0	0	0	0	0	0	0	0	0
Mechanical equipment (no) Tiller	0	0	0	0	0	0	0	0	0	0

4.6.17. Allocation and Utilization of watershed budget

The allocation and utilization of the watershed budget is shown in Table 4.147. The management components like administration cost, community organization and training programme did not receive any outlay. Out of the development component, 82 per cent were spent on conservation measures on the arable land. Conservation measures on the non arable land received only 7 per cent of the total budget. Components like livelihood support system for landless families, women based activities, fodder and fuel wood production also did not receive any thrust.

4.6.18. Constraints in the watershed development programme

The major constraints experienced by the sample farmers were identified and ranked. Non-availability of irrigation water, inadequacy of sanctioned amount, lack of supervision and follow-up, lack of technical guidance, and insufficient credit availability were the major constraints. Lack of awareness about the beneficial programme indicated that stakeholder

Table.4:147. Allocation and Utilization of budget in *Pulikkalthodu* watershed

Sl.No.	Components	Allocation of funds (Rs)	% to total
A	Management components	-	-
B	Development component		
I	Arable land		
	Repair of the existing stone bund	4035	0.36
	Repair of the existing earthen bund	4,90,705	44.02
	Gully control measures	1,65,685	14.86
	Moisture conservation pits	1125	0.10
	Centripetal terraces	2,56,129	22.98
	Sub total for conservation measures	***9,17,679***	***82.32***
II	Non arable land		
	Live fencing	6000	0.54
	Gully control measures	71,912	6.45
	Sub total for conservation measures	***77,912***	***6.99***
	Drainage line treatment		
	Upper reaches	56,449	5.06
	Middle reaches	18,616	1.67
	Lower reaches	44,154	3.96
	Sub total for drainage line treatment	***1,19,219***	***10.69***
	Grand Total	**11,14,810**	**100.00**

Table 4.148. Constraints in the watershed development programme in *Pulikkalthodu* watershed

Sl.No.	Constraint	Rank
1	Non-availability of irrigation water	1
2	Inadequacy of sanctioned amount	2
3	Lack of supervision and follow-up	3
4	Lack of technical guidance	4
5	Insufficient credit availability	5
6	Untimely availability of inputs and subsidy from Krishi Bhavan	6
7	Lack of awareness about the beneficial programme	7
8	Political interference	8

participation was low. Though political interference was perceived as a constraint, it was perceived as of lower importance by the beneficiary farmers.

The following conclusions can be made from the above analysis.

- The programme could make a positive impact on soil erosion and the widely adopted measures such as mulching, stone bunding and fencing with live trees helped to reduce erosion hazards.
- The water harvesting structures increased the groundwater availabity in the area. The ground water status in the project area improved compared to non-project area.
- There was nearly 3.8 percent increase in the area used for agricultural purposes. There was marginal increase in the availability of fodder and this decreased the expenses on livestock rearing.
- The productivity of major crops grown in the area, viz., coconut, rice, banana, and rubber increased during the project period.
- Although the cost of cultivation per hectare for coconut, rice, banana, and rubber recorded increase compared to the pre-project period, it translated into higher farm income per hectare.
- Utilization of labour also increased during the post-project period, indicating generation of more rural employment opportunities. Labour use per hectare substantially increased for coconut, rubber, arecanut, pepper and banana.
- The project could not address components like livelihood support system for landless families, women based activities, fodder and fuel wood production.
- The major constraints observed were non-availability of irrigation water, inadequacy of fund sanctioned for the projects, lack of supervision and follow-up, lack of technical guidance, and insufficient credit availability.

4.7. CHARAL WATERSHED

4.7.1. Family size

The distribution of respondents based on family size showed that 70 per cent of the beneficiaries had a family size upto 5 members while 30 per cent had 6-7 members in their family (Table 4.149). In the non beneficiaries group 84 per cent had a family size upto 5 members while 12 per cent of the families had 6-7 members.

Table 4.149. Family size of the sample farmers in *Charal* watershed

Sl.No.	Family size	Beneficiaries	Non-beneficiaries
1	Less than 5	35 (70.00)	21 (84.00)
2	6-7	15 (30.00)	3 (12.00)
3	Above 7	0	1 (4.00)
	Total	**50 (100.00)**	**25 (100.00)**

Figures in parentheses indicate percentage to the respective totals)

4.7.2. Age

The classification of respondents on the basis of age is given in Table 4.150. There were 26 beneficiaries (52 percent) above 55 years of age, whereas 24(48 per cent) belonged to the age group between 35-55 years. While majority of the non beneficiaries belonged to age group above 55 years (52 per cent) 40 per cent belonged to the age group between 35-55 years and 8 per cent less than 35 years of age. This shows that there is no dearth of manpower in the project area.

Table 4.150 . Age group of the sample farmers in *Charal* watershed

Sl.No	Age group (Years)	Beneficiaries	Non-beneficiaries
1	Less than35	0	2 (8.00)
2	35-55	24 (48.00)	10 (40.00)
3	More than 55	26 (52.00)	13 (52.00)
	Total	**50 (100)**	**25 (100)**

(Figures in parentheses indicate percentage to the respective totals)

4.7.3 Educational status

The educational background of the people of the project area is also a factor that influences the implementation of the programmes. The results as shown in Table 4.151revealed that majority of the beneficiaries had education upto pre-degree level (46 per cent), while 21 per cent were graduates.. Only 8 per cent of the beneficiaries were illiterate.

Table 4.151. Educational level of the sample farmers in *Charal* watershed

Sl.No.	Educational level	Beneficiaries	Non-beneficiaries
1	Illiterate	9(8)	3(4)
2	Formal schooling	28(25)	24(32)
3	Pre degree	52(46)	24(32)
4	Graduation	23(21)	24(32)
	Total	**112(100)**	**75(100)**

(Figures in parentheses indicate percentage to the respective totals)

Compared to this illiterates is marginally less among non beneficiaries (4 per cent). 32 per cent each of the non beneficiaries had education at primary, pre degree and graduation level.

4.7.4. Family income

The majority of the beneficiary belonged to the income group of more than 1,00,000 (Table 4.152). Hardly 16 per cent of the beneficiary farmers belonged to less than 50000 income group, while 44 per cent of non beneficiary farmers belonged to this income group.

Table 4.152. Annual family income of the sample farmers in *Charal* watershed

Sl.No.	Family income per annum (Rs)	Respondents	
		Beneficiary	Non-beneficiary
1	Less 50, 000	8 (16.00)	11 (44.00)
2	50, 000-100,000	10 (20.00)	10 (40.00)
3	Above 100, 000	32 (64.00)	4 (16.00)
	Total	**50 (100.00)**	**25 (100.00)**

4.7.5. Land use pattern

The watershed development programme has not brought about considerable changes in the pattern of land use for agriculture. (Table 4.153).

4.7.6. Cropping Pattern

Analysis of the cropping pattern of the respondents as shown in Table 4.154 revealed that rubber occupied 70 per cent of the total cropped area of the beneficiary farmers. This

Table 4.153. Land use pattern of the sample farmers in *Charal* watershed (in ha)

Sl.No.	Land use	Beneficiaries		Non-beneficiaries
		Before WDP	After WDP	
1	Agriculture	1.39	1.40	0.66
2	Non agriculture	0.08	0.07	0.09
	Total	**1.47**	**1.47**	**0.75**

was followed by coconut (16.43 per cent), arecanut (10.00 per cent) and pepper (2.86 per cent). In the case of the non-beneficiary farmers also rubber constituted the major crop (60.60 per cent). Coconut (25.76 per cent) and arecanut (10.61 per cent) were the other crop components.

Table 4.154. Cropping pattern of the sample farmers in *Charal* watershed (in ha)

Sl.No.	Crops	Beneficiaries	Non-beneficiaries
1	Coconut	0.23 (16.43)	0.17 (25.76)
2	Pepper	0.04 (2.86)	0.01 (1.52)
3	Arecanut	0.14 (10.00)	0.07 (10.60)
4	Rubber	0.98 (70.00)	0.40 (60.60)
5	Banana	0.01 (0.71)	0.01 (1.52)
	Total	**1.4 (100.00)**	**0.66 (100.00)**

(Figures in parentheses indicate percentage to the respective totals)

4.7.7. Cropping Intensity of the farmers

The cropping intensity of the respondent farmers are worked out and presented in Table 4.155. It can be noted that the cropping intensity was low, and there was no significant difference in the cropping intensity of beneficiary and non beneficiary farmers. The low cropping intensity is on account of the domination of perennial crops in the cropping pattern, which provides less flexibility for area that can be sown more than once.

Table 4.155. Cropping intensity of the sample farmers in *Charal* watershed

Sl.No.	Category	Gross sown area (ha/farm)	Net sown area (ha/farm)	Cropping intensity (%)
1	Beneficiary	1.4	1.38	101.45
2	Non-beneficiary	0.66	0.65	101.54

4.7.8. Labour use pattern

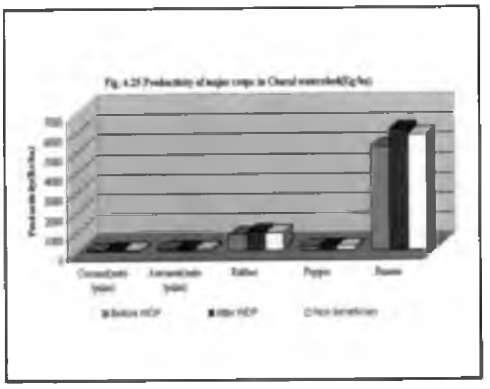
The labour use pattern as shown in Table 4.156 showed an increase in labour use following the implementation of the project in case of beneficiaries. The increase in labour use per hectare was substantial for coconut, rubber, arecanut and banana.

Table 4.156. Labour use pattern of the sample farmers in *Charal* watershed (man days per ha)

Sl.No.	Crops	Beneficiary			Non beneficiary	Percentage change over control
		Before WDP	After WDP	Percentage change over time		
1	Coconut	88	111	26.14	110	0.91
2	Arecanut	87	100	14.94	89	12.36
3	Pepper	103	118	14.56	114	3.51
4	Rubber	111	129	16.22	128	0.78
5	Banana	148	169	14.19	164	3.05
	Mean	**107**	**125**	**16.82**	**121**	**3.31**

4.7.9. Productivity of major crops

Results as presented in Table 4.157 indicated the productivity of major crops in the study area. It was found that productivity of coconut increased from 32 nuts per palm to 41 nuts per palm in the watershed area and it was 37 nuts per palm in the non watershed area. The productivity of rubber which is the major crop in the watershed area has shown



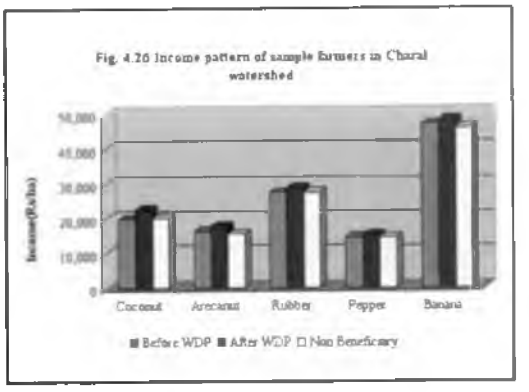


Fig. 4.26 Income pattern of sample farmers in Charal watershed
Coconut
Arecanut
Rubber
Pepper
Banana
Before WDP
After WDP
Non Beneficiary

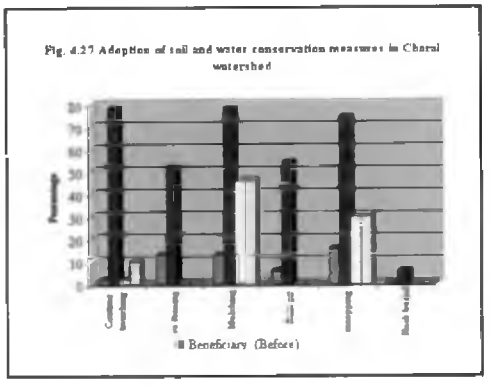


Fig. 4.27 Adoption of soil and water conservation measures in Charal watershed
Beneficiary (Before)

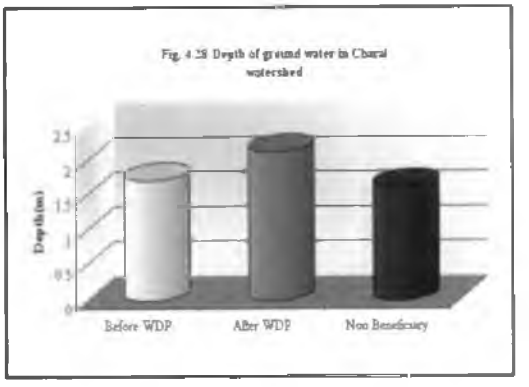
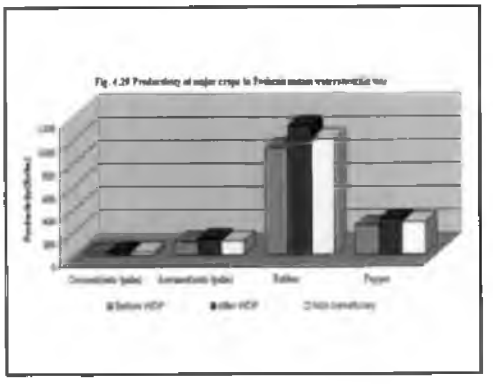


Fig. 4.28 Depth of ground water in Charal watershed
Depth (m)
Before WDP
After WDP
Non Beneficiary



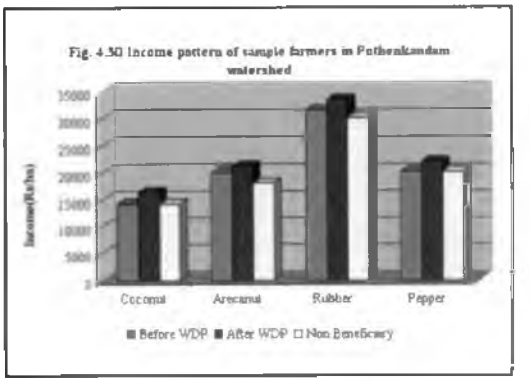


Fig. 4.30 Income pattern of sample farmers in Puthenkandam watershed
Coconut
Arecanut
Rubber
Pepper
Before WDP
After WDP
Non Beneficiary

considerable increase from 812 kg per ha to 962 kg per ha, and that of pepper increased from 183 kg per ha to 216 kg per ha (Fig.4.25).

Table 4.157. Productivity of major crops in *Charal* Watershed

Sl. No.	Crops	Beneficiary			Non beneficiary	Percentage change over control
		Before WDP	After WDP	Percentage change over time		
1	Coconut (nuts /palm)	32	41	28.13	37	10.81
2	Arecanut (nuts /palm)	96	120	25.00	105	14.29
3	Rubber (Kg/ha)	812	962	18.47	922	4.34
4	Pepper (Kg/ha)	183	216	18.03	206	4.83
5	Banana (Kg/ha)	5230	6090	16.44	5811	4.80

4.6.9 Crop wise farm expenses

A crop wise analysis of the cost of cultivation per hectare as presented in Table 4.158,4.159,4.160,4.161 and 4.162 showed that coconut, arecanut and banana reported substantial change in expenses. For coconut the increase was from Rs. 15515 before WDP to Rs. 17091 (at 1998-99 constant prices) .In the case of banana the cost increase was from Rs. 36152 to Rs 36752 (at 1998-99 constant prices). The expenses incurred for arecanut increased from Rs. 14197 to Rs. 14936.The increased cost of cultivation could be attributed to the increased human labour use, manures, plant protection measures etc. There is increase in the cost of manures, fertilizers as well as human labour use in case of rubber, banana and arecanut.

4.7.11 Income pattern

The farm income of the farmers in the project area and non project area as depicted in Table 4.163 revealed that the income per hectare from coconut for the beneficiaries increased from Rs. 19968 before WDP to Rs. 22539 in the project area while it was Rs. 20340 for the non project area. A crop wise analysis of the farm income per hectare revealed that rubber, pepper, banana and arecanut showed substantial increase in income for the beneficiaries after implementation of the programme (Fig.4.26).

Table 4.158. Input wise farm expenses for coconut crop in *Charal* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	9650	12,230	10,775	12,100	10,660
2	Seeds	3310	3813	3359	2997	2640
3	Manures	2023	2693	2373	1963	1729
4	Fertilizers	396	515	454	819	722
5	PP chemicals	136	148	130	0	0
	Total	**15, 515**	**19, 399**	**17, 091**	**17, 879**	**15, 751**

Table 4.159. Input wise farm expenses for arecanut crop in *Charal* watershed(Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	9550	11,030	9717	9780	8616
2	Seeds	3232	4253	3747	3963	3491
3	Manures	940	1125	991	1060	934
4	Fertilizers	475	546	481	536	472
5	PP chemicals	0	0	0	0	0
	Total	**14, 197**	**16, 954**	**14, 936**	**15, 339**	**13, 513**

4.7.12. Livestock Status

The watershed programmme had given thrust to livestock management projects; and there was significant increase in the number of livestock owned by the beneficiaries as a

Table 4.160. Input wise farm expenses for banana crop in *Charal* watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	16,310	18,620	16,404	18,080	15,928
2	Seeds	8222	9666	8516	9300	8193
3	Manures	7560	8630	7603	8250	7268
4	Fertilizers	1960	2300	2026	2320	2044
5	PP chemicals	2100	2500	2203	2200	1938
	Total	**36,152**	**41,716**	**36,752**	**40,150**	**35,371**

Table 4.161. Input wise farm expenses for pepper crop in Charal watershed (Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	11,330	12,985	11,440	12,550	11,057
2	Seeds	396	480	423	452	398
3	Manures	1800	2250	1982	2050	1806
4	Fertilizers	330	423	373	420	370
5	PP chemicals	263	322	284	333	293
	Total	**14,119**	**16,460**	**14,502**	**15,805**	**13,924**

result of the implementation of the programme. It could be seen from Table 4.164 that only 6 respondents owned goat while 28 of them owned cow and 22 had poultry as a result of the programme. Before the programme only 12 had cow and 4 had poultry.

Table 4.162. Input wise farm expenses for rubber crop in *Charal* watershed (Rs/ha

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP (at 1998-99 prices)	After WDP (at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	12,200	14,180	12,493	14,120	12,439
2	Seeds	3522	4227	3724	4066	3582
3	Manures	994	1251	1102	1066	939
4	Fertilizers	282	329	290	1035	912
5	PP chemicals	59	72	64	101	89
	Total	**17, 057**	**20, 059**	**17, 673**	**20, 388**	**17, 961**

Table 4.163 Income pattern of the sample farmers in *Charal* watershed (Rs/ha

Sl. No.	Crops	Beneficiary				Non beneficiary	
		Before WDP (1998-99)	After WDP				
			At current prices (2003-04)	At constant prices (1998-99)	Percentage change at constant prices	At current prices (2003-04)	At constant prices (1998-99)
1	Coconut	19,968	25,584	22,539	12.88	23,088	20,340
2	Arecanut	16,320	20,400	17,972	10.12	17,850	15,725
3	Rubber	27,608	32,708	28,815	4.37	31,348	27,617
4	Pepper	14,640	17,280	15,223	3.98	16,480	14,518
5	Banana	47,070	54,810	48,287	2.59	52,299	46,075
	Mean	**25, 121**	**30, 156**	**26, 567**	**5.67**	**28, 213**	**24, 855**

The households who owned livestock had received the benefits undertaken in the project. But this has not brought benefit on a community basis. It is evident from Table 4.165 and 4.166 that the farmers earn considerable amount of profit through livestock rearing. Majority

of the people were willing to undertake rearing of livestock as a profitable means of livelihood.

Table 4.164. Livestock status of the sample farmers in *Charal* watershed (No. / farm)

Sl.No.	Category	Beneficiaries		Non beneficiaries	
		Before WDP	After WDP	Before WDP	After WDP
1	Cow	12	28	4	3
2	Goat	0	6	0	2
3	Pig	0	0	0	0
4	Poultry	4	22	2	30

Table 4.165. Cost of livestock production in *Charal* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At current Prices (2003-04)	At constant prices (1998-99)
			At current Prices (2003-04)	At constant Prices (1998-99)		
1	Concentrate	2763	2940	2590	3017	2658
2	Dry fodder	1062	963	848	1087	957
3	Labour charge	1063	1296	1142	1352	1191
4	Miscellaneous expenses	293	354	312	366	323
	Total	**5181**	**5553**	**4892**	**5822**	**5129**

4.7.13. Soil and water conservation measures

Soil conservation and water conservation are the two most important programmes under the watershed projects. An assessment of the extent of participation of beneficiaries in these two programmes is essential to evaluate the impact of the project. The responses of both beneficiaries and non beneficiaries in this area of development have been assessed with reference to their knowledge and level of practicing the same.

Table 4.166. Livestock Income in *Charal* watershed (Rs/animal/year)

Sl.No.	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP			
			At current Prices (2003-04)	At constant Prices (1998-99)	At current Prices (2003-04)	At constant Prices (1998-99)
1	Milk	9783	11,415	10,057	9800	8634
2	Dung	1250	1577	1390	1216	1072
Total		**11, 033**	**12, 992**	**11, 447**	**11, 016**	**9706**

There was general improvement in the knowledge and practicing of soil conservation in the watershed areas. (Table 4.167 and Fig.4.27). There was general awareness about the need and method of construction of contour bunds. The number of farmers who adopted contour trenching after the implementation of the project was 19, which was only two before the project. The construction of rain pits and mulching formed the other major conservation measures. 27 farmers constructed rainwater harvesting pits and 39 farmers undertook mulching. The positive impact of the watershed is reflected in the increase in the

Table 4.167. Adoption of soil and water conservation measures in *Charal* watershed (no: of respondents)

Sl.No.	Category	Beneficiaries		Non-beneficiaries	
		Before WDP	After WDP	Before WDP	After WDP
1	Contour trenching	2	19 (78)	1 (2)	5 (10)
2	Live fencing	13	26 (52)	0 (0)	0 (0)
3	Mulching	13	39 (78)	23 (46)	23 (46)
4	Rain pit	6	27 (54)	0 (0)	0 (0)
5	Intercropping	16	37 (74)	15 (30)	15 (30)
6	Husk burial	0	3 (6)	0 (0)	0 (0)

(Figures in parentheses indicate percentage to the respective totals)

number of beneficiaries adopting the soil conservation measures. None of the non-beneficiaries have implemented the conservation measures.

4.7.14. Organic matter content of the soil

The organic matter content of the soil was analysed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 0.9 to.2.1 percent in the beneficiary sample with a mean of 1.2. In the control plot the range was from 1.0 to 2.6 per cent and the mean was 1.4. The average content of organic matter in the soil was higher for the non beneficiaries when compared to the beneficiaries.

4.7.15. Ground water status

Table 4.168 is based on the number of wells owned by the beneficiaries and non-beneficiaries. Out of the 50 beneficiaries, 42 of them owned wells and 4 had ponds in their households. In the non-beneficiary group, 23 households had their own well and only 3

Table 4.168 . Assistance for rain water harvesting structures in *Charal* watershed (Number)

Sl.No.	Respondents	Well	Pond
1	Beneficiaries	42 (3)	4 (1)
2	Non Beneficiaries	23 (1)	3 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

household had pond. Following the implementation of watershed programme, 3 of these beneficiaries had availed the benefits provided for renovation of the wells and 3 of them received the benefits for renovating the ponds. It was observed that the non beneficiaries did not adopt any of these renovation measures.

A study on average depth of ground water indicated that in beneficiaries' sample, there is considerable difference in the lowest depth before WDP and after WDP; highest depth has increased from 2.73m (before WDP) to 3.43 m (after WDP). In non beneficiaries' sample, we can observe that lowest depth and highest depth is 0.54 m and 2.74m respectively (Table 4.169). The watershed programme has brought about a positive impact on the moisture regime(Fig. 4.28). The advantage on ground water recharge was not felt by the non-beneficiaries.

Table 4.169. Depth of Ground water in *Charal* watershed (in meters)

Sl.No.	Beneficiary	Before WDP	After WDP	% increase
a	Lowest	0.74	0.86	16.21
b	Highest	2.73	3.43	25.64
c.	Average	1.74	2.15	23.56
	Non Beneficiary			
a	Lowest	-	0.54	3.85
b	Highest	-	2.74	1.48
c.	Average	-	1.64	-

4.7.16 Distribution of inputs for Beneficiary

Distribution of inputs to beneficiary as given in Table 4.170 revealed that that planting materials of coconut, mango, arecanut and cashew were distributed to the beneficiaries, which was distributed through *Krishibhavans*. Agro forestry and composite nursery programmes were also implemented as a part of the watershed programmes. Crop demonstrations were conducted with emphasis on intercrops along with fodder cultivation programmes .

4.7.17. Allocation and Utilization of watershed budget

The allocation and utilization of watershed budget is presented in Table 4.171. There was a total outlay of Rs.24.95 lakhs, of which 15.51 per cent were earmarked for the management components while 84.49 per cent were earmarked for the development components.

Conservation measures in the arable land received 43.19 per cent of the development funds. Under this head, repair of the existing conservation measures got 38.21 per cent of the out lay. Treatments in non arable land consisted of live fencing, contour hedges and drainage treatments. Bank stabilization measures with vegetative measures and loose boulder check dams were the main components of drainage line treatments. Livestock management system received 5 per cent of the watershed budget.

4.7.18. Constraints in the watershed development programme

The major constraints experienced by the sample farmers were identified while conducting the survey. The constraints were non-availability of Irrigation water, inadequacy of sanctioned amount, lack of supervision and follow-up, lack of technical guidance,

Table 4.170. Distribution of inputs for Beneficiary in *Charal* watershed

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	KAU	Total	KB	Private	KAU	Co-op	Total
Planting materials (no:)	0	0	0	0	0	2690	0	0	0	2690
Arecanut	0	0	0	0	0	31773	0	0	0	31773
Cashew graft	0	0	0	0	0	4000	0	0	0	4000
Mangograft	0	0	0	0	0	725	0	0	0	725
Pepper cuttings						2933	0	0	0	2933
Jack seedlings						725	0	0	0	725
Teak stump						2000	0	0	0	2000
Fodder seed						4kg	0	0	0	4kg
Organic manure (kg)	0	0	0	0	0	13332	0	0	0	13332
Fertilizer (no:)	0	0	0	0	0	0	0	0	0	0
PPchemicals (ml)	0	0	0	0	0	0	0	0	0	0
Mechanical equipment (no) Tiller	0	0	0	0	0	0	0	0	0	0
Cattleshed (no. of farmers) 31	0	0	0	0	0	30	0	0	0	30

insufficient credit availability, untimely availability of inputs and subsidy from Krishi Bhavan, lack of awareness about the beneficial programme and political interference (Table 4.172). It was found that lack of awareness about the programme was the most important constraint in the project area followed by untimely availability of inputs and subsidy from Krishi Bhavan. The other constraints were lack of technical guidance, inadequacy of sanctioned amount, non-availability of irrigation water, insufficient credit availability and political interference.

Table 4.171. Allocation and Utilization of budget in *charal* watershed

Sl.No.	Components	Allocation of funds (Rs)	Percentage to total
A	Management components	3,86,964	15.51
B	Project activities		
I	Arable land		
	Repair of the existing conservation measures	9,53,615	38.21
	Gully control measures	11,930	0.48
	Centripetal terraces	1,12,320	4.50
	Sub total for conservation measures	***10,77,865***	***43.19***
	Sub total for Production systems	***2,25,400***	***9.03***
II	Non arable land		
	Live fencing	92,190	3.69
	Vegetative contour hedges	1,30,000	5.21
	Sub total for conservation measures	***2,22,190***	***8.90***
	Sub total for Production systems	***1,21,872***	***4.88***
	Bank stabilization	45,060	1.81
	Loose boulder check dams	2,89,361	11.59
	Sub total for drainage line treatment	***3,34,421***	***13.40***
	Sub total for livestock management	***1,27,000***	***5.09***
	Grand Total	**24, 95,712**	**100.00**

Table 4.172. Constraints in the watershed development programme in *Charal* watershed

Sl.No.	Constraint	Rank
1	Lack of awareness about the beneficial programme	1
2	Untimely availability of inputs and subsidy from Krishi Bhavan	2
3	Lack of technical guidance	3
4	Inadequacy of sanctioned amount	4
5	Non-availability of irrigation water	5
6	Insufficient credit availability	6
7	Political interference	7
8	Lack of supervision and follow-up	8

The following conclusions are drawn from the above analyses

- There was general awareness about the need and method of construction of contour bunds. The positive impact of the watershed programme is reflected in the increase in the number of beneficiaries adopting the soil conservation measures like contour trenching, construction of earthen bunds, terracing, and mulching. It was observed that funds for maintenance of these structures were not available which resulted in poor maintenance of structures. None of the non-beneficiaries have implemented the conservation measures.

- The water harvesting techniques like rain pits and digging and renovation of wells were instrumental in raising the depth of water table in the water shed. There was significant rise in the water levels of the beneficiaries indicating a positive impact on the moisture regime.

- The watershed development programme has not brought about much changes in the pattern of land use for agriculture.

- There has been an increase in employment generation on account of the increase in labour use following the implementation of the project in case of beneficiaries. The increase in labour use per hectare was substantial for coconut, rubber, arecanut and banana.

- The increase in crop productivity as a result of various factors like increased human labour use increase in manure application and increased moisture availability have been translated into higher farm income in nominal as well as real terms. The average farm income increased to the tune of 4.63 per cent in real terms.

- Watershed Development Programmes have brought out certain changes in livestock production systems using increased quantity of fodder, improvement of livestock management systems etc. There was an increase in the livestock population during the post project period. The livestock income also recorded an increase in real terms during this period

- There was increase in green fodder availability among beneficiary farmers. Cultivation of fodder crops as a part of crop farming, raising of fodder trees in the farm fences, have facilitated abundant green fodder.

- The project could not make any perceptible impact on cropping pattern, cropping intensity and soil fertility status.

- There were no efforts to have conservation measures in non-arable land. The success of watershed development crucially depends on the holistic approach, whereby arable and non arable land receives priority in treatments.

- There was no fund earmarked for the maintenance civil works beyond the project period. Once the government support and funding ceased, it could lead to the neglect of civil works and conservation efforts already made. This led to a situation where there was no sustainability of conservation measures adopted.

- The project failed to make any impact on women and landless people .A greater degree of inter-agency coordination between the Department of Agriculture, Department of Soil Conservation, Department of Animal Husbandry, Department of Dairying and Forest Department are required for effective implementation of programmes.

- Though NWDPRA Guidelines advocates people's participation in the success of the watershed development programme, people's participation in the project planning and implementation was low in the project under reference.

- It was found that lack of awareness about the programme was the most important constraint in the project area followed by untimely availability of inputs and subsidy from Krishi Bhavan. The other constraints were lack of technical guidance, inadequacy of sanctioned amount, non-availability of irrigation water, insufficient credit availability and political interference.

4.8 POTHANKANDAM WATERSHED

4.8.1. Family size

The distribution of respondents based on family size showed that 78 per cent of the beneficiaries had a family size upto 5 members while 20 per cent had 6-7 members in their family (Table 4.173). In the non beneficiaries group 92 per cent had a family size upto 5 members while 8 per cent of the families had 6-7 members.

Table 4.173. Family size of the sample farmers in *Pothankandam* watershed

Sl.No.	Family size	Beneficiaries	Non beneficiaries
1	Less than 5	39 (78)	23 (92)
2	Between 6-7	10 (20)	2 (08)
3	More than 7	1 (02)	0 (00)
	Total	**50 (100)**	**25 (100)**

(Figures in parentheses indicate percentage to the respective totals)

4.8.2. Age

The classification of respondents on the basis of age is given in Table 4.174.There were 30 beneficiaries (60 per cent) belonging to the age group between 35-55 years and 20 (40 per cent) beneficiaries were above 55 years of age. While majority of the non beneficiaries belonged to age group between 35-55 years (56 per cent) only 24 per cent were above 55 years of age. This shows that there is no dearth of manpower in the project area.

Table 4.174. Age group of the sample farmers in *Pothankandam* watershed

Sl.No.	Age group (Years)	Beneficiaries	Non beneficiaries
1	Less than35	0	5(20)
2	Between 35-55	30(60)	14(56)
3	More than 55	20(40)	6(24)
	Total	**50(100)**	**25(100)**

(Figures in parentheses indicate percentage to the respective totals)

4.8.3. Educational status

The educational background of the people of the project area is also a factor that influences the implementation of the programmes. The results as shown in Table 175 revealed that majority of the beneficiaries had primary education (66 per cent) while nearly 9 per cent of them were illiterate. Compared to this illiterates is marginally higher among non beneficiaries (14 per cent) .About 70 per cent of the non beneficiaries had primary education. The illiterate and poor people may hesitate to accept the programmes and they will need intensive training and demonstration programmes.

Table 4.175. Educational level of the sample farmers in *Pothankandam* watershed

Sl.No.	Educational level	Beneficiaries	Non beneficiaries
1	Illiterate	18(9)	13(14)
2	Formal schooling	139(66)	67(70)
3	Pre degree	31(15)	11(12)
4	Graduation	21(10)	4(04)
	Total	**210(100)**	**95 (100)**

(Figures in parentheses indicate percentage to the respective totals)

4.8.4.Family Income

The majority of the beneficiary belonged to the income group of more than 1,00,000 (Table 4.176). Hardly 22 per cent of the beneficiary farmers belonged to less than 50000 income group, while 48 per cent of non beneficiary farmers belonged to this income group.

Table 4.176. Annual family income of the sample farmers in *Pothankandam* watershed

Sl.No.	Family income per annum (Rs)	Respondents	
		Beneficiary	Non-beneficiary
1	Less than50, 000	11(22.00)	12(48.00)
2	50, 000-100,000	16(32.00)	11(44.00)
3	Greater than 100, 000	23(46.00)	2 (8.00)
4	Total	50 (100.00)	25 (100.00)

4.8.5. Land use pattern

The watershed development programme has brought about changes in the pattern of land use for agriculture. (Table 4.177). There was nearly 1.05 per cent increase in the area used for agricultural purposes by the beneficiaries, while there was no change in the land utilization pattern among the non beneficiaries.

Table 4.177. Land use pattern of the sample farmers in *Pothankandam* watershed (in ha)

Sl.No.	Land use	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Agriculture	0.95	0.96	0.33
2	Non agriculture	0.04	0.03	0.13
Total		**0.99**	**0.99**	**0.46**

4.8.6. Cropping pattern of the sample farmers

Analysis of the cropping pattern of the respondents as shown in Table 4.178 revealed that rubber occupied nearly 53 per cent of the total cropped area of the beneficiary farmers. This was followed by coconut (26.04 per cent), arecanut (12.5 per cent) and pepper (8.33 per cent).

Table 4.178. Cropping pattern of the sample farmers in *Pothankandam* watershed (in ha)

Sl.No	Crops	Beneficiaries	Non-beneficiaries
1	Coconut	0.25 26.04)	0.07 (21.21)
2	Rubber	0.51 (53.13)	0.22 (66.67)
3	Pepper	0.08 (8.33)	0.01 (3.03)
4	Arecanut	0.12 (12.5)	0.03 (9.09)
5	Total	0.96 (100.00)	0.33 (100.00)

(Figures in parentheses indicate percentage to the respective totals)

4.8.7. Cropping Intensity of the farmers

The cropping intensity of the respondent farmers are worked out and presented in Table 4.179. It can be noted that the cropping intensity was low, and there was no significant difference in the cropping intensity of beneficiary and non beneficiary farmers. The low cropping intensity is on account of the domination of perennial crops in the cropping pattern, which provides less flexibility for area that can be sown more than once.

Table 4.179. Cropping intensity of the sample farmers in *Pothankandam* watershed

Sl.No	Category	Gross sown area (ha/farm.)	Net sown area (ha/farm.)	Cropping intensity (%.)
1	Beneficiary	0.96	0.95	101.1
2	Non-beneficiary	0.33	0.32	103.1

4.8.8. Labour use pattern

The labour use pattern as shown in Table 4.180 showed an increase in labour use following the implementation of the project in case of beneficiaries. The increase in labour use per hectare was substantial for coconut, rubber, arecanut and pepper.

Table 4.180. Labour use pattern of the sample farmers in *Pothankandam* watershed (mandays per ha)

Sl.No	Crops	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Coconut	75	91	88
2	Arecanut	89	100	95
3	Pepper	77	90	89
4	Rubber	112	129	95

4.8.9. Productivity of major crops

Table 4.181 indicated the productivity of major crops in the watershed and non watershed area. Results revealed that productivity of coconut increased from 23 nuts per palm to 30 nuts per palm in the watershed area and it was 26 nuts per palm in the non watershed area. The productivity of rubber which is the major crop in the watershed area has shown considerable increase from 926 kg per ha to 1115 kg per ha, and that of pepper increased from 253 kg per ha to 313 kg per ha. The difference in the productivity was significant among the beneficiaries and as compared to non beneficiaries in case of crops like rubber, coconut, pepper and arecanut (Fig. 4.29).

Table 4.181. Productivity of major crops in *Pothankandam* watershed

Sl.No	Crops	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Coconut (nuts /palm)	23	30	26
2	Arecanut (nuts /palm)	118	142	121
3	Rubber(Kg/ha)	926	1115	1006
4	Pepper(Kg/ha)	253	313	286

4.8.10. Crop wise farm expenses

A crop wise analysis of the cost of cultivation per hectare as presented in Table 4.182,4.183,4.184 and 4.185 showed that coconut, pepper and rubber reported substantial change in expenses. For coconut the increase was from Rs.13749 before WDP to Rs. 14510 (at 1998-99 constant prices) .In the case of rubber the cost increase was from Rs. 17628 to Rs 18233 (at 1998-99 constant prices). The expenses incurred for pepper increased from Rs. 19113 to Rs. 20310.The increased cost of cultivation could be attributed to the increased human labour use, manures, plant protection measures etc.

Table 4.182. Input wise farm expenses for coconut crop in *Pothenkandam* watershed(Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	8250	10,060	8863	9630	8484
2	Seeds	4575	5257	4631	4558	4016
3	Manutres	696	847	745	989	871
4	Fertlizers	231	307	271	253	223
5	PP chemicals	0	0	0	0	0
Total		**13,749**	**16,471**	**14,510**	**15,430**	**13,594**

Table 4.183. Input wise farm expenses for arecanut crop in *Pothenkandam* watershed(Rs/ha)

Sl.No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	8450	9930	8748	9780	8616
2	Seeds	1020	1679	1479	1406	1239
3	Manutres	5523	6359	5602	4603	4055
4	Fertlizers	86	103	91	123	108
5	PP chemicals	0	0	0	0	0
Total		**15,079**	**18,071**	**15,920**	**15,912**	**14,018**

4.8.11. Income pattern

The farm income of the farmers in the project area and non project area as depicted in Table 4.186 revealed that the income per hectare from coconut for the beneficiaries increased from Rs. 14352 before WDP to Rs. 16492 in the project area while it was Rs.

Table 4.184. Input wise farm expenses for pepper crop in *Pothenkandam* watershed(Rs/ha)

Sl:No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	9830	10,970	9665	10,450	9205
2	Seeds	4623	6636	5846	6224	5483
3	Manutres	2134	2425	2137	1907	1680
4	Fertlizers	1633	1985	1749	1856	1635
5	PP chemicals	893	1036	913	993	875
Total		**19,113**	**23,052**	**20,310**	**21,430**	**18,878**

Table 4.185. Input wise farm expenses for rubber crop in *Pothenkandam* watershed(Rs/ha)

Sl:No.	Input	Beneficiary			Non beneficiary	
		Before WDP (at 1998-99 prices)	After WDP			
			(at 1998-99 prices)	(at 2003-04 prices)	(at 1998-99 prices)	(at 2003-04 prices)
1	Human labour	12,300	14,180	12,493	14,120	12,440
2	Seeds	3587	4337	3821	3257	2869
3	Manutres	1169	1445	1273	1114	982
4	Fertlizers	420	548	483	403	355
5	PP chemicals	152	185	163	0	0
Total		**17,628**	**20,695**	**18,232**	**18,894**	**16,646**

14293 for the non project area. A crop wise analysis of the farm income per hectare revealed that rubber, pepper and arecanut showed substantial increase in income for the beneficiaries after implementation of the programme (Fig. 4.30).

Table 4.186. Income pattern of the sample farmers in *Pothenkandam* watershed (Rs/ha)

Sl.No	Crops	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At Current Prices (2003-04)	At Constant Prices (1998-99)
			At current Prices (2003-04)	At constant Prices (1998-99)		
1	Coconut	14352	18720	16492	16224	14293
2	Arecanut	20060	24140	21267	20570	18122
3	Rubber	31484	37910	33399	34204	30134
4	Pepper	20240	25040	22060	22880	20157

4.8.12. Livestock Status

The livestock population is quite insufficient to meet the requirement of the people in the area. Hence scientific management of livestock, supply of improved breeds, good quality cattle food etc was given thrust in the Watershed Development Programmes.

As a result of the thrust given by the watershed programmme to livestock management projects, there was increase in the number of livestock owned by the beneficiaries. The number of families who adopted cow rearing as an additional occupation increased from 11 to 24. (Table 4.187). Three families took up goat rearing and poultry rearing as an additional occupation.

Table 4.187. Livestock status of the sample farmers in *Pothenkandam* watershed (No. / farm)

Sl.No	Category	Beneficiaries		Non beneficiaries
		Before WDP	After WDP	
1	Cow	11	24	6
2	Goat	0	2	1
3	Pig	0	0	0
4	Poultry	0	1	24

It is evident from Table 4.188 and 4.189 that the farmers who owned livestock earned considerable amount of profit. The farmers should be given inputs such as good quality cattle and goats in addition to providing veterinary assistance, extension services etc. These will the momentum and thrust to prosper the livestock population in the watershed.

Table 4.188. Cost of livestock production in *Pothenkandam* watershed (Rs/animal/year

Sl. No	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At current Prices (2003-04)	At constant Prices (1998-99)
			At current Prices (2003-04)	At constant Prices (1998-99)		
1	Concentrate	3266	3505	3088	3850	3392
2	Dry fodder	1860	1770	1559	1975	1740
3	Labour charge	1236	1520	1339	1400	1233
4	Miscellaneous expenses	136	129	114	126	111
5	Total	6498	6924	6100	7351	6476

Table 4.189. Livestock Income in *Pothenkandam* watershed (Rs/animal/ year)

Sl.No	Item	Beneficiaries			Non beneficiaries	
		Before WDP	After WDP		At current Prices (2003-04)	At constant Prices (1998-99)
			At current Prices (2003-04)	At constant Prices (1998-99)		
1	Milk	9326	11905	10488	9426	8304
2	Dung	1123	1790	1577	1227	1081
3	Total	10449	13695	12065	10653	9385

4.8.13. Soil and water conservation

Poor infiltration during monsoon months caused rapid depletion in moisture condition of surface horizons and consequent moisture stress to cultivated crops during summer months. Soil conservation and water conservation are the two most important programmes under the watershed projects. An assessment of the extent of participation of beneficiaries in these two programmes is essential to evaluate the impact of the project.

The responses of the both beneficiaries and non beneficiaries in this area of

development have been assessed with reference to their knowledge and level of practicing the same. There was general improvement in the knowledge and practicing of soil conservation in the watershed areas (Fig. 4.31). It was noticed that in total there was increase in the traditional soil conservation activities by the beneficiaries after implementing the programme. (Table 4.190). The positive impact of the watershed is reflected in the increase in the number of beneficiaries adopting the soil conservation measures. None of the non-beneficiaries have implemented the conservation measures. Contour bunding, rain pits, live fencing and husk burial were the various activities implemented under the project for conservation of soil and moisture. There was low acceptability for practices like trenching and construction of water harvesting structures. An important feature that is to be noted with concern is the low acceptance of even contour bunding, an easily doable practice. Operational problem could possibly be one of the reason for this lack of acceptance or it could be even due to the lack of adequate knowledge.

Table 4.190. Adoption of soil and water conservation measures in *Pothenkandam* watershed(no: of the respondents)

Sl.No	Category	Beneficiaries		Non-Beneficiaries	
		Before WDP	After WDP	Before WDP	After WDP
1	Contour bunding	1 (2)	3 (6)	0 (0)	0 (0)
2	Trenching	3 (6)	6 (12)	0 (0)	0(0)
3	Live fencing	12 (24)	27 (54)	9 (36)	9 (36)
4	Mulching	26 (52)	38 (76)	14 (56)	14 (56)
5	Rain pit	2 (4)	27 (54)	0 (0)	0 (0)
6	Inter cropping	15 (30)	36 (72)	22 (88)	22 (88)
7	Husk burial	2 (4)	9 (18)	0 (0)	0 (0)

(Figures in parentheses indicate percentage to the respective totals)

4.8.14.Organic matter content of the soil

The organic matter content of the soil was analysed both in the beneficiary sample as well as the control plots. It was found that the organic matter ranged from 0.7 to 8.2 percent in the beneficiary sample with a mean of 3.3. In the control plot the range was from 2.8 to 8.7 per cent and the mean was 4.1. he average content of organic matter in the soil was higher for the non beneficiaries when compared to the beneficiaries. The variation may not be due to the implementation of the watershed programme alone.

4.8.15. Ground water status

Table 4.191 is based on the number of wells owned by the beneficiaries and non-beneficiaries. Out of the 50 beneficiaries, 38 of them owned wells and 3 had ponds in their households. 6 of the beneficiaries had availed the benefits of renovation of well and one of them for renovation of pond. In the non-beneficiary group, 11 households had their own

Table 4.191. Assistance for rain water harvesting structures in *Pothenkandam* watershed (Number)

Sl.No	Respondents	Well	Pond
1	Beneficiaries	38 (6)	3 (1)
2	Non Beneficiaries	11 (0)	0 (0)

(Figures in parentheses indicate the number of respondents who availed benefits)

well and three households had ponds. Following the implementation of watershed programme, one of these beneficiaries had availed the benefits provided for renovation the ponds. The number of stake holders being less in these areas, there is need for more of such efforts directed to the maintenance of the physical structures used for rainwater harvesting. It should be kept in mind that the indigenous systems of resource conservation and harvesting should receive considerable importance in this area.

A study on average depth of ground water indicates that in beneficiaries' sample, there is difference in the lowest depth before WDP and after WDP: highest depth has

Table 4.192. Depth of Ground water in *Pothenkandam* watershed (in meters)

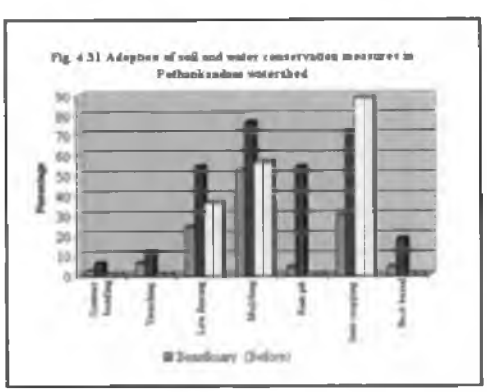
Sl.No	Beneficiary	Before WDP	After WDP	Percentage increase
a	Lowest	0.93	1.01	8.6
b	Highest	2.85	2.98	4.56
	Non Beneficiary			
a	Lowest	-	0.56	0
b	Highest	-	2.40	0

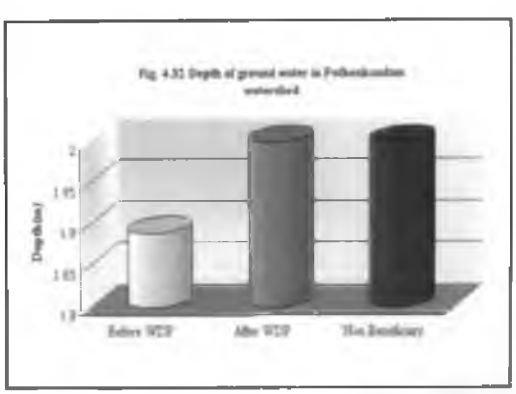
Plate 13. Neglected loose boulder check dam in Elanad

Plate 14. Neglected stream embankment in Pallichal

Plate 15. Sand mining and quarrying in Elanad

Plate 16. Indiscriminate quarrying in Pulikkalthodu





increased from 2.85m (before WDP) to 2.98m (after WDP). In non beneficiaries' sample, we can observe that lowest depth and highest depth was 0.56 m and 2.40 m respectively (Table 4.192). The advantage on ground water recharge was not felt by the non-beneficiaries (Fig.4.32).

4.8.16. Distribution of inputs for Beneficiary

Distribution of inputs to beneficiary as given in Table 4.193 revealed that planting materials of coconut, mango, arecanut and cashew were distributed to the beneficiaries, which was distributed through Krishibhavans. Agro forestry and composite nursery programmes were also implemented as a part of the watershed programmes. Crop demonstrations were conducted with emphasis on intercrops along with fodder cultivation programmes. The beneficiaries were given subsidies for construction and repairing of cattle sheds.

Table 4.193. Distribution of inputs for Beneficiary in *Pothenkandam* watershed

Inputs	Institution (Before WDP)					Institution (After WDP)				
	KB	Private	NGO	KAU	Total	KB	Private	KAU	Co-op	Total
Planting materials (no:)										
Coconut	0	0	0	0	0	2775	0	0	0	2775
Mango	0	0	0	0	0	500	0	0	0	500
Cashew	0	0	0	0	0	2500	0	0	0	2500
Arecanut	0	0	0	0	0	15225	0	0	0	15225
Agro forestry	0	0	0	0	0	4850	0	0	0	4850
Fertilizer (no:)	0	0	0	0	0	202	0	0	0	202
Crop demonstration	0	0	0	0	0	300	0	0	0	300
Repair of cattle sheds (No)	0	0	0	0	0	65	0	0	0	65
Construction of cattle sheds	0	0	0	0	0	25	0	0	0	25
Fodder cultivation	0	0	0	0	0	25	0	0	0	258

4.8.17. Allocation and Utilization of watershed budget

The project was carried out at a total outlay of Rs.36.83 lakhs, of which 24.72 was utilized for management activities while 75.28 per cent was devoted to development activities.

Table 4.194. Allocation and Utilization of budget in *Pothankandam* watershed

Sl.No.	Components	Allocation of funds (Rs)	Percentage to total
A	Management components	***9,10,472***	***24.72***
B	Project activities		
I	Arable land		
	Repair of the existing conservation measures	3,37,292	9.16
	Gully control measures	32,267	0.88
	Centripetal terraces	99,727	2.71
	Contour vegetative hedges	2364	0.06
	Vegetative filter strips	38,816	1.05
	Small dug out pits	3,25,845	8.85
	Sub total for conservation measures	***11,25,311***	***30.55***
	Sub total for Production systems	***3,64,519***	***9.90***
II	Non arable land		
	Live fencing	1,02,798	2.79
	Gully control measures	2,06,511	5.61
	Sub total for conservation measures	***3,09,309***	***8.40***
	Sub total for Production systems	***2,81,850***	***7.65***
	Bank stabilization	37,367	1.01
	Loose boulder check dams	94,016	2.55
	Small dug out ponds	1,50,333	4.08
	Water silt collection devices	1,34,839	0.95
	Loose boulder check dams with vegetative support	1,09,564	2.97
	Renovation of existing ponds	8396	0.23
	Sub total for drainage line treatment	***5,34,815***	***14.52***
	Sub total for livestock management	***1,56,944***	***4.26***
	Grand Total	**36, 83, 220**	**100.00**

9 farmers' trainings, 6 *mithra kissan* trainings and 9 staff trainings were conducted under the basic activities.

Conservation measures in the arable land received nearly 31 per cent of the project funds. Repair of the existing conservation measures, gully control measures centripetal terraces, vegetative filter strips and dug out pits were undertaken under this head.400 demonstrations of *vermi composting* were conducted under the production systems. Conservation measures under the non arable land consisted of live fencing and gully control measures. Under the livestock management system 100 cattle sheds were renovated at an outlay of Rs.1 lakh. However, women specific activities did not receive any coverage under the project components.

4.8.18. Constraints in the watershed development programme

The major constraints experienced by the sample farmers were identified while conducting the survey and presented in Table 4.195. The constraints were lack of awareness about the beneficial programme, lack of technical guidance, untimely availability of inputs and subsidy from Krishi Bhavan, insufficient credit availability, inadequacy of sanctioned amount, lack of supervision and follow up, Non-availability of irrigation water and political interference. It was found that lack of awareness of the beneficial programme was the most important constraint in the project area followed by lack of technical guidance, Untimely availability of inputs and subsidy from Krishi Bhavan also was found to be an important problem, while the least important problem was political interference. The other problems pointed out by some of the beneficiaries were lack of time, incidence of pests and diseases, passive attitudes of the people, irresponsibility of Watershed Committee and the formalities in the Krishibhavan etc.

Table 4.195. Constraints in the watershed development programme in *Pothenkandam*

Sl.No.	Constraint	Rank
1	Lack of awareness about the beneficial programme	1
2	Lack of technical guidance	2
3	Untimely availability of inputs and subsidy from Krishi Bhavan	3
4	Insufficient credit availability	4
5	Inadequacy of sanctioned amount	5
6	Lack of supervision and follow-up	6
7	Non-availability of irrigation water	7
8	Political interference	8

The following conclusions are made from the above analysis:

- Nearly 63 per cent of the watershed is strongly sloping to very steep, thus vulnerable to serious soil erosion. The land holding pattern indicated the predominance of small and marginal farmers (98.75 per cent). Agriculture formed the main occupation in the watershed area. Out of 1054 ha of arable land, 145 ha was lowlands. However, paddy was not cultivated in the watershed. Coconut was the main cultivated crop. The productivity of coconut was low due to unscientific cultivation and lack of irrigation facilities.

- The watershed development programme was carried out at a financial outlay of Rs.26.82 lakhs, out of which the management and development components received 27.19 and 72.81 percentages of the watershed budget respectively. The repair of existing contour measures and gully control measures received more thrust in the arable land treatments. 400 crop demonstrations were carried out in the watershed area. In the nom arable land, drainage line treatment and planting of trees received more attention. Considering the mutual dependence between crop and livestock components, livestock management activities were also given adequate focus through the renovation of cattle sheds and cultivation of fodder.

- There was general improvement in the knowledge and practice of soil and water conservation measures. The adoption of contour bunding, rain pitting, live fencing and husk burial were high; but practices like construction of water harvesting structures and trenching had low acceptability.

- There was no discernible impact of the programme on the level of education, land use pattern or cropping pattern of the beneficiaries.

- There was improvement in the ground water status of the beneficiary farmers. The average depth of ground water increased by 5.82 per cent during the project period. The average water table of the beneficiary farmers was 33.78 per cent higher than that of the non beneficiary farmers, indicating the positive impact of the programme on ground water recharge.

- The increased moisture availability resulted in higher crop productivity in the watershed area. The crop productivity increased by 20 per cent in arecanut and rubber to 23 per cent in pepper. The highest change in productivity was observed in coconut (30 per cent).

- A noticeable change was observed in the labour use pattern of the beneficiary farmers in cropping. The labour use on an average increased by nearly 16 per cent

on per hectare basis after the implementation of the programme. The labour use intensity varied from 15-16 per cent in pepper and rubber to 21 per cent in coconut.

- Three was no marked change in the green cover and microclimate, especially in the non arable land.
- No improvements were noticed in the soil fertility status as reveled by the soil test data.
- The drainage line treatments were effective. It improved the stream bank stabilization, and resulted in better drainage. The quality of different works were satisfactory.
- There were no schemes for women specific activities, and landless households. No impact was visible in this area.
- There was increase in livestock population among the beneficiaries. The cost of livestock rearing declined. there was reduction in the cost of fodder, which contributed to higher livestock income realizations.
- The programme could not make any impact on firewood availability.
- There was improvement in the family asset due to adoption of soil and conservation practices.
- The erosion level declined as evidenced by less sedimentation in drainage flow.
- The training programmes were effective as evidenced by higher level of adoption soil and water conservation measures. 400 crop demonstrations were laid out in the watershed. But, innovative research components were missing in the programme.
- The effectiveness of watershed community in project planning and implementation was low. The selection of species for live fencing was not finalized on a participatory mode.
- Lack of awareness about the programme, lack of technical guidance, untimely availability of sanctioned amount were the major constraints experienced by the stakeholders.

4.9. SUMMARY OF IMPACT EVALUATION

Watershed management required a high level of location specificity and flexibility in the choice of technology for production as well as conservation. However, there is a "common

approach for watershed development" that binds various watershed components into a watershed framework. Hence, the following conclusions are made by the evaluation team based on the analyses discribed in the previous section, and based on the spot assessment made after visiting and interacting with officials and stakeholders in the various watersheds under reference:

❑ **Impact on arable land**

- ***Changes in ground water status***

Ground water level is an important parameter in watershed functioning. Hydrological literature indicates that groundwater availability is a function of recharge, which depends *inter alia* on the volume and intensity of rainfall, the topography, soil type, rock type, the degree of weathering of rocks underneath and the degree of recharge effort. The recharge effort, in turn, is improved by better infiltration through barriers like check dams, farm ponds, percolation ponds etc. This is part of the hydrological cycle in the watershed unit that augments ground water resources (Buras, 1975; Gowing *et al,* 1992; Chandrakanth and Diwakara, 2001). The conservation, utilization and management of natural resources in a watershed are evolved and designed primarily to address and balance this hydrological cycle. Considered from this angle, all the watersheds under reference could result in improved ground water status.

The change in groundwater status varied from moderate improvement in *Pallichal, Naranganam, Kunjithanny, Pulickalthodu* and *Pothenkandam* to substantial improvement in *Uppukandam, Elanadu* and *Charal* watersheds.

- ***Changes in green cover and microclimate***

Although no vegetation mapping and microclimatic monitoring were carried out in the project, the feedback and observation of the team indicated that there was not much pronounced change in green cover and thereby microclimate. The exceptions were *Pallichal, Elanad* and *Uppukandam* watersheds. A major reason for absence of perceptible change in green cover and microclimatic changes is the predominance of home garden agriculture in the arable land. It is a coconut based agro forestry system evolved over the years, where the multi-tiered root and canopy structure provide less room for dramatic tinkering. It may also be borne in mind that soil and water conservation measures such as contour trenching, terracing, vegetative bunding, small check dams etc. may not result in dramatic and immediate impact in the non arable land. They can accelerate the rehabilitation of the microenvironment over a reasonably longer period of time only.

- ***Changes in soil fertility status***

All the watersheds under reference were prone to high soil erosion due to the undulating topography and high rainfall pattern (The mean annual rainfall was above 2500 mm). The barriers introduced could reduce the soil erosion in most watersheds. Organic matter status showed varying values, and no definite conclusion could be drawn on soil fertility status.It is presumed that measures of soil and water conservation may result in fertility status changes over a much more pronounced time horizon only.

- ***Sustainability of conservation measures adopted***

Soil and water conservation measures are substantially labour and capital intensive practices. The beneficiary farmers are tempted to have 'pseudo-adoption' due to strong social pressure, subsidies or other financial incentives. Once the government support and patronage are withdrawn, the maintenance of the assets created is anybody's guess. The neglect was more visible in the case of common properties like farm ponds, percolation tanks etc.

The sustainability of the conservation efforts will be ensured only if the watershed community takes active interest and involve in the upkeep and maintenance of the assets created. The selection of species for live fencing is a classical example. Whenever the components were multipurpose components like *Glyricidia* or *Hibiscus*, farmers attended to its maintenance. However, when components like *Lentana* were included without stakeholder preference, there was lack of enthusiasm in the maintenance as in the case of *Kunjithanny* and *Pothenkandom* watersheds.

❑ **Impact on crop production**

- ***Changes in productivity***

The increased availability of soil moisture with better farming practices resulted in higher crop productivity in all the major crops cultivated in the watershed area. The increase in crop productivity was the highest for coconut, varying from 22 per cent increase in *Uppukandam* watershed, to 75 per cent increase in *Kunjthanny* watershed. It ranged from18 per cent increase in *Elanadu* watershed to 24 per cent increase in *Naranganam* watershed for paddy crop. In pepper, the increase varied from 14 per cent in *Kunjthanny* watershed to 26 per cent in *Pallichal* watershed. This increase was in the range of 15 to 24 percent in banana; 14 to 29 per cent in rubber; 4 to 7 per cent in coffee and 15 to 18 per cent in cardamom.

- ***Changes in cropping pattern***

No marked cropping pattern changes associated with watershed development were observed in the arable land. A major reason could be the domination of perennial crops in

the cropping pattern, which provided less flexibility for cropping pattern changes as in the case of seasonal or annual crops. Whatever limited changes noticed were on account of fodder grass cultivation in the interspaces and fodder trees in the farm boundaries. Practically, very little changes in land utilization were noticed in the non arable land.

- ***Changes in cropping intensity***

Cropping pattern and cropping intensity changes associated with watershed development in the dry land agricultural systems, where seasonal and annual crops dominate the pattern was conspicuously absent in this case. Cropping intensity of beneficiary farmers was low, and did not differ significantly from that of non beneficiary farmers.

❑ **Impact on non arable land**

- ***Impact of conservation measures***

All the watersheds under reference were prone to high soil erosion due to the peculiar physiographic features. The barriers introduced could reduce the soil erosion in most watersheds under reference. In certain cases, there were untreated areas in the non-arable land due to insufficient fund allocation (eg. *Kuntjithanny* and *Elanad* watersheds), indicating that the non-arable land did not receive equal treatment as the case of arable land. This is against the watershed principles. The non-arable lands were largely under the ownership and control of the Forest/ Revenue Department, local bodies or common properties. Lack of treatment in the upper reaches will result in more run off in the middle and lower reaches, and thereby more erosion. Any integrated watershed strategy shall embrace elements of mechanical measures, conservation agronomy, conservation forestry and interface agro forestry in the arable as well as non arable land.

❑ **Impact on drainage related aspects**

- ***Efficiency of stream bank stabilization***

The drainage line treatments were largely effective. The thrust was indigenous measures like construction of soil harvesting structures, terracing, small sized dug out ponds, stone/vegetative checks, filters, vegetative filters and stabilization of banks etc. This resulted in wider adoption of the practices. There was reduction in sedimentation in the drainage flow.

- ***Changes in water flow***

The promotion of vegetation in the catchment area by construction of check dams in drainage lines and continuous contour trenches in the uncultivated catchment areas could check erosion and reduce the silting in the storage capacity of water harvesting structures. As a result, the water flow in the drainage increased.

- ***Quality of different works***

The quality of different items of work was satisfactory. The team came across serious complaints about the quality of works in *Kunjithany* watershed where substandard works were encountered. Breaches and collapses were noticed at many locations of the drain banks in some areas of *Pallichal* watershed also.

☐ **Socioeconomic impact**

- ***Changes in income generation***

Any watershed management strategy shall have a long term perspective of full conservation and realization of natural resources in the region with efficiency, equity and sustainability. However, there shall be a short to medium term perspective of providing immediate benefits to the participating community. In all the watersheds under reference, the production advantages were translated into monetary advantages through higher income realizations by the stakeholders from crop production. The incremental income generation varied from 4 percent in *Pulikkalthode* watershed to 12 percent in *Pallichal* watershed in real terms. Only *Kunjithanny* and *Uppukandam* watersheds lagged in incremental income generation with a meager increase of 0.73 and 0.83 percentages respectively.

- ***Changes in employment***

There was an increase in employment generation from crop husbandry in the watershed areas under reference. The employment generation due to higher labour use in crop production varied from 10 percent in *Elanadu* watershed to 16 percent in *Pallichal, Naranganam, Uppukandam, Pulikkathodu* and *Pothenkandom* watersheds. It was as high as to 17 percent in *Charal* watershed. This is an equity aspect, whereby the agriculturists passed on a share of incremental income generated to the agricultural labourers of the locality.

- ***Impact on women***

Although the guidelines for the projects emphasized the need for promoting women based activities, in practice the project did not create a substantial role for women or addressed their interests in a meaningful manner. The actual watershed committees also had less women representation. Women based activities were not identified in many watershed projects. The women folk were benefited indirectly from the livestock development programmes through less time devoted for the collection of fodder, and higher livestock income in certain cases.

- ***Impact on landless households***

The watershed programme did not address the landless households appropriately. So, it failed to make any decisive impact on the landless households directly or indirectly.

- ***Impact on family asset, education and domestic expenditure pattern***

The farm investments through renovation of wells, ponds, cattle shed etc. resulted in more farm assets being created. But it could not result in improvements in education or domestic consumption. The programmes did not visualize any linkages between watershed development and educational level on the one hand, and watershed development and domestic expenditure pattern on the other.

❑ **Impact on ecology**

- ***Reduced soil erosion***

The barriers introduced could reduce the soil erosion in most watersheds under reference except *Naranganam*, *Kunjithanny, Elanad* and *Charal* watersheds. The evaluation team came across large scale environmental degradation caused specifically by unscrupulous quarrying in some watershed areas. This was of alarming proportions in *Pulikkalthode* watershed (plate 4.7). Similarly, wetlands are important drainage points for a watershed. The team came across indiscriminate conversion of wet paddy lands for other agricultural or non agricultural uses like construction, brick making etc. Wetland conservation shall form an integral component of any watershed management programme.

- ***Enhanced water harvesting***

The project activities could result in increased water harvesting in all the watersheds under review though the level of water harvesting varied from watershed to watershed.

- ***Change in firewood availability***

The component for increasing firewood availability was not properly operationalzed in any of the watersheds reviewed by the team. There were sporadic attempts to supply forestry seedlings in some watersheds. But, they did not receive the thrust required for increasing firewood availability.

❑ **Impact on livestock related aspects**

- ***Change in livestock population***

The ownership of livestock was fairly high among the beneficiary farmers. The impetus given for the development of livestock through increased fodder cultivation and improved maintenance has created a positive impact on the watershed regions as the farmers earned more income through livestock rearing in most cases. The livestock income also recorded increase in real terms for the participating watershed community in *Pallichal, Kunjithanny, Elanadu, Charal* and *Pothenkandam* watersheds.

- ***Change in fodder production and availability***

There was increase in green fodder cultivation and availability in *Pallichal, Kunjithanny, Uppukandam* and *Elanadu* watersheds. But, no impact on this count was observable in *Naranganam, Pulikkalthodu, Charal* and *Pothenkandom* watersheds.

❑ **Institutional impact**

- ***Effectiveness of watershed community in project planning and implementation***

Although watershed development is to be planned, implemented, monitored and maintained by the watershed communities, participatory approach in project planning and implementation was conspicuous by its absence or remained at low levels. It is an irony that in spite of increased water availability, the problem of scarcity of water for irrigation continued to vex many farmers. It was indicative of the inappropriate institutional arrangement for benefit sharing among the stakeholders Lack of awareness about the programme also remained as a major constraint in most watersheds. Its inference is that watershed community by and largely remained as "passive recipients" rather than "participatory stakeholders".

- ***Effectiveness of training programmes***

The training programmes were effective. It resulted in higher adoption of conservation practices like rainwater pits, contour trenches, stone pitched contour bunds, live fencing, mulching, cover cropping, husk burial etc. However, there was no fund earmarked for training programme at *Naranganam, Kunjithanny, Elanadu* and *Pulikkalthodu* watersheds or the financial outlay was meager as in the case of *Pallichal*, and *Charal* watersheds.

The evaluation team came across reclamation of wet paddy lands for the cultivation of annual crops like tapioca and banana or perennial crops like arecanut and coconut. There was widespread sand mining and quarrying prevalent in some watersheds like *Elanad* and *Pulikkalthodu* (Plates 15 and 16). These activities can cause irrepairable damage to the watershed, and can in some extreme casess even nullify the conservation efforts being made. Hence, it is a matter of serious concern to be addressed in the context of integrated watershed management .

CHAPTER 5
SUMMARY AND RECOMMENDATIONS

The quest by human race for better conservation, use and management of available water is as old as human civilization. The depleting per capita availability of land and water, two fundamental production inputs, coupled with increasing competition for its use calls for a more planned development of them. Therefore, any watershed development programme should ensure efficient land and water resource management for sustainable agricultural production, which in turn, ensure economic development of the watershed community, who is directly or indirectly dependant on the watershed. It must also strive to maintain the ecological balance in the project area.

The present evaluation was carried out with the specific objectives of evaluating the impact of NWDPRA implementation in Kerala in terms of physical achievements, agronomic changes and socio-economic benefits; to assess the changes in land use pattern and cropping pattern in the area; to examine the income and employment generation from agriculture and allied activities; and to analyze the constraints experienced in implementation of the programme in the State during the Ninth Five Year Plan. The evaluation was undertaken in eight watershed, having an area of 500-1000 ha from *Thiruvananthapuram, Pathanamthitta, Idukki, Thrissur, Palakkad* and *Kannur* districts, from the list of watersheds where NWDPRA was implemented during the Ninth Plan, in consultation with the officials of the State Department of Agriculture and the project implementation agencies. Thus, *Pallichal* watershed from *Thiruvanathapuram* district, *Naranganam* watershed from *Pathanamthitta, Kunjithanny* and *Uppukandam* watersheds from *Idukki, Elanad* watershed from *Thrissur, Pulikkalthodu* watershed from *Palakkad, Charal* and *Pothenkandam* watersheds from *Kannur* were ultimately selected.

The secondary data required for the evaluation was collected from records maintained by the Implementation Committee of the respective watersheds. The primary data was collected by interviewing the sample farmers by means of a structured, pre-tested schedule of enquiry. From each watershed, 50 beneficiaries were selected randomly. 25 respondents were selected from the non-project area for comparing the impact as a control group, thus making a total sample size of 400 beneficiary farmers and 200 non beneficiary farmers as control group. Due to the multiplicity of goals and activities, a set of performance indicators were used to assess the impact of the programme instead of a single indicator. The following impact indicators were used to capture the multidimensional impact of the programme:

- Arable land
  - Changes in ground water status
  - Changes in green cover and microclimate
  - Changes in soil fertility status
  - Sustainability of conservation measures adopted
- Crop Production
  - Changes in productivity
  - Changes in cropping pattern
  - Changes in cropping intensity
- Non arable land
  - Impact of conservation measures
- Drainage related indicators
  - Efficiency of stream bank stabilization
  - Changes in water flow
  - Quality of different items of work
- Socio-economic indicators
  - Changes in income generation
  - Changes in employment
  - Impact on women
  - Impact on landless people
  - Impact on family asset, education and domestic expenditure pattern
- Ecological indicators
  - Reduced soil erosion
  - Enhanced water harvesting

- Changes in fire wood availability
- Livestock based indicators
- Changes in livestock population
- Changes in fodder production and availability

- Institutional indicators
  - Effectiveness of watershed community in project planning and implementation
  - Effectiveness of training programmes

The primary data pertains to the pre project period of 1998-99, and the post project period of 2003-04. As the observations were measured in current prices, the Agricultural Wholesale Index (AWI) was used to deflate the current prices, and all comparisons were made at the 1998-99 constant prices. The mean and percentage analysis were carried out to analyze the data in accordance with the objectives of the evaluation. Organic carbon of the soil was estimated using wet digestion method for the soil samples collected from both the beneficiaries as well as the non-beneficiary farmers, and the soil organic matter content worked out. The constraint analysis was carried out by the scoring method, and each constraint ranked based on the score obtained.

The major findings obtained through the evaluation is given below under the following headings:

☐ **Impact on Arable land**

- ***Changes in ground water status***

There was positive impact of the programme on groundwater status in all the watersheds under reference. The increase was on account of enhanced recharge. The increase in groundwater status varied from moderate improvement in *Pallichal*, *Naranganam*, *Kunjithanny*, *Pulickalthodu* and *Pothenkandam* to substantial improvement in *Uppukandam*, *Elanadu* and *Charal* watersheds.

- ***Changes in green cover and microclimate***

Although no vegetation mapping and microclimatic monitoring were carried out in the project, the feedback and observation of the team is that there were not much pronounced change in green cover and microclimate. The exceptions were *Pallichal*, *Elanad* and *Uppukandam* watersheds.

- ***Changes in soil fertility status***

All the watersheds under reference were prone to high soil erosion due to the undulating topography and high rainfall pattern (The mean annual rainfall was above 2500 mm). The barriers introduced could reduce the soil erosion in most watersheds.However, based on the findings on organic matter status, no definite conclusion on soil fertility could be drawn. It is presumed that measures of soil and water conservation may result in fertility status changes over a much more pronounced time horizon only.

- ***Sustainability of conservation measures adopted***

Soil and water conservation measures are substantially labour and capital intensive practices. The beneficiary farmers are tempted to have 'pseudo-adoption' due to strong social pressure, subsidies or other financial incentives. Once the government support and patronage are withdrawn, the maintenance of the assets created is anybody's guess. The neglect was more visible in the case of common properties like farm ponds, percolation tanks and streambank embankments.

The sustainability of the conservation efforts live fencing was good wherever multipurpose species like *Glyricidia* or *Hibiscus* were selected.However, when components like *Lentana* with low potential for biomass production were included without stakeholder preference, there was lack of enthusiasm in the maintenance as in the case of *Kunjithanny* and *Pothenkandom* watersheds.

☐ **Impact on Crop production**

- ***Changes in productivity***

The increased availability of soil moisture with better farming practices were converted into higher crop productivity in all the major crops cultivated in the watershed area. The increase in crop productivity varied across crops and watersheds.

- ***Changes in cropping pattern***

No marked cropping pattern changes associated with watershed development were observed in the arable land. A major reason could be the domination of perennial crops in the cropping pattern, which provided less flexibility for cropping pattern changes as in the case of seasonal or annual crops. Whatever limited changes noticed were on account of fodder grass cultivation in the interspaces and fodder trees in the farm boundaries. Practically no land utilization changes were noticed in the non arable land.

- ***Changes in cropping intensity***

- ***Changes in cropping intensity***

Cropping pattern and cropping intensity changes associated with watershed development in the dry land agricultural systems, where seasonal and annual crops dominate the pattern was conspicuously absent in this case. Cropping intensity of beneficiary farmers was low, and did not differ significantly from that of non beneficiary farmers.

☐ **Impact on non arable land**

- ***Impact of conservation measures***

All the watersheds under reference were prone to high soil erosion due to the peculiar physiographic features. The barriers introduced could reduce the soil erosion in most watersheds under reference. In certain cases, there were untreated areas in the non-arable land due to insufficient fund allocation (eg. *Kuntjithanny* and *Elanad* watersheds), indicating that the non-arable land did not receive equal treatment as the case of arable land. This is against the watershed principles. The non-arable lands were largely under the ownership and control of the Forest/ Revenue Department, local bodies or common properties. Lack of treatment in the upper reaches will result in more run off in the middle and lower reaches, and thereby more erosion.

☐ **Impact on Drainage related aspects**

- ***Efficiency of stream bank stabilization***

The drainage line treatments were largely effective. As the thrust was on indigenous measures like construction of soil harvesting structures, terracing, small sized dug out ponds, stone and/or vegetative checks, vegetative filters and stabilization of banks etc., there was higher adoption of the conservation practices. This resulted in reduction in sedimentation in the drainage flow.

- ***Changes in water flow***

The promotion of vegetation in the catchment area by construction of check dams in drainage lines and continuous contour trenches in the uncultivated catchment areas could check erosion and reduce the silting in the storage capacity of water harvesting structures. As a result, the water flow through the drainage lines increased.

- ***Quality of different works***

The quality of different items of work was satisfactory. However, the team came across serious complaints about the quality of works in *Kunjithany* watershed where substandard works were encountered. Breaches and collapses were noticed at many locations of the drain banks in some areas of *Pallichal* watershed also.

☐ **Socioeconomic impact**

- ***Changes in income generation***

The production advantages were translated into monetary advantages through higher income realizations by the stakeholders from crop production in all the watersheds under reference. The incremental income generation varied across crops and watersheds.

- ***Changes in employment***

There was increase in employment generation from crop husbandry in the watershed areas under reference. The employment generation due to higher labour use in crop production varied from 10 percent in *Elanadu* watershed to 17 percent in *Charal* watershed. This is an equity aspect, whereby a portion of the incremental income generated were passed on to the agricultural labourers of the locality.

- ***Impact on women***

Although the guidelines for the projects emphasized the need for promoting women based activities, in practice the project did not create a substantial role for women or addressed their interests in a meaningful manner. The actual watershed committees also had less women representation. Women based activities were not identified in many watershed projects. The women folk were benefited indirectly from the livestock development programmes through less time devoted for the collection of fodder, and higher livestock income in certain cases.

- ***Impact on landless people***

The watershed programme did not address the landless households appropriately. Therefore, it failed to make any decisive impact on the landless households directly or indirectly.

- ***Impact on family assets, education and domestic expenditure pattern***

The farm investments through renovation of wells, ponds, cattle shed etc. resulted in more farm assets being created. However, it could not result in improvements in education or domestic consumption. The programmes did not visualize any linkages between watershed development and educational level on the one hand, and watershed development and domestic expenditure pattern on the other.

☐ **Impact on ecology**

- ***Reduced soil erosion***

The barriers introduced could reduce the soil erosion in most watersheds under reference except *Naranganam, Kunjithanny, Elanad* and *Charal* watersheds. The evaluation team

came across large scale environmental degradation caused specifically by unscrupulous quarrying in some watershed areas. Similarly, the team came across indiscriminate conversion of wet paddy lands for other agricultural or non agricultural uses like construction, brick making etc. Wetland conservation should form an integral component of any watershed management programme.

- ***Enhanced Water harvesting***

The project activities could result in increased water harvesting in all the watersheds under review though the level of water harvesting varied from watershed to watershed.

- ***Change in Firewood availability***

The component for increasing firewood availability was not properly operationalzed in any of the watersheds reviewed by the team. There were sporadic attempts to supply forestry seedlings in some watersheds. But, they did not receive the thrust required for increasing firewood availability.

☐ **Impact on Livestock related aspects**

- ***Change in livestock population***

The ownership of livestock was fairly higher among the beneficiary farmers. The impetus given for the development of livestock through increased fodder cultivation and improved maintenance has created a positive impact on the watershed regions as the farmers earned more income through livestock rearing in most cases. The livestock income also recorded increase in real terms for the participating watershed community in *Pallichal, Kunjithanny, Elanadu, Charal and Pothenkandam* watersheds.

- ***Change in fodder production and availability***

There was increase in green fodder cultivation and availability in *Pallichal, Kunjithanny, Uppukandam* and *Elanadu* watersheds. But, no impact on this count was observable in *Naranganam, Pulikkalthodu, Charal* and *Pothenkandom* watersheds.

☐ **Institutional impact**

- ***Effectiveness of watershed community in project planning and implementation***

Participatory approach in project planning and implementation was either absent or remained at low levels. In spite of increased water availability, the problem of scarcity of water for irrigation continued to vex many farmers. It was indicative of the inappropriate institutional arrangement for benefit sharing among the stakeholders. Lack of awareness

about the programme also remained as a major constraint in most watersheds. Its inference is that watershed community by and largely remained as "passive recipients" rather than "participatory stakeholders".

- ***Effectiveness of training programmes***

The training programmes were largely effective. It resulted in higher adoption of conservation practices like rainwater pits, contour trenches, stone pitched contour bunds, live fencing, mulching, cover cropping, husk burial etc. However, some cases were noticed where no fund was earmarked for training programme or it remained inadequate.

RECOMMENDATIONS

Considering the magnitude of public investment in watershed development programmes, and in the light of the main findings discussed above, the following recommendations are being made for making the watershed development programmes more effective :

1) In all rural development programmes, villages or *panchayats* are the basic planning unit for revenue or administrative convenience. Even for implementing officials and participating watershed community, village and farm boundaries are the natural boundaries than the hydrological boundaries. The rationale of watershed as a natural planning unit shall receive more recognition. This has more relevance in the benefit sharing by stakeholders, especially in sharing the harvested water.

2) People's participation is a dynamic group process in which all the participating members contribute towards the attainment of group objectives, and share the benefits. People's participation is a prime requirement for the effectiveness of multi-dimensional programmes like this. Otherwise, conservation structures and implementation committees may get dissolved once the government assistance and patronage are withdrawn. Hence, there shall be farmer empowerment based on farmers' right to organize, maintain and use resources in a watershed area.

3) Even though every watershed plan had components of research trials and testing, and innovative support, the evaluation team could not come across any meaningful research or trials being carried out in this regard. Research trials or documentation of such vital information as reduction in run off, soil erosion, sedimentation, indigenous production and conservation practices etc. shall form a strategic information in watershed planning and component selection.

4) Institutional constraints like poor coordination between participating agencies should not be allowed to impair the full realization of potential benefits in a "multi-resource" and "multidisciplinary" development programme like watershed development. Although minor irrigation works constituted an integral component of watershed development, the Department of Minor irrigation was not represented in many watershed committees. Similarly, the Forest and Fisheries Departments were also not adequately represented in some reference watersheds. Multi-agency participations are absolutely necessary for the successful planning and implementation of livestock, fodder, forestry and firewood components.

5) Local capacity building assumes a key role in "multi-resource" and "multidisciplinary" development programme like watershed development. Unfortunately, government programmes give more thrust on the physical and financial target achievements, which permits less time for "processes". Public funded programmes of this magnitude shall be less 'target oriented', and more 'outcome oriented'. The intensity and coverage of trainings given to implementing officers were also low. As trainings and micro-level capacity building are crucial for the success of programmes of this nature, the training programmes in future shall consider the process of local capacity building.

6) There is need for a right balance between management and development activities on the one hand, and engineering and vegetative measures on the other. That is why the "guidelines" advocated a proportion of 22.50 : 77.50 between management and development activities in a watershed. But, most watersheds under reference did not maintain this balance. There were instances when certain watersheds did not have fund for basic activities, and utilized almost the entire amount on project activities. Similarly, within the project activities, more importance was given to engineering works and less priority was accorded on vegetative conservation. It may be reminded that in the universal soil loss equation of A = RKLSCP, the crop management component C is taken care of by the vegetative or agronomic practices while P factor, representing the support practice represent the techniques such as bunding, terracing etc. As the use of C factor can reduce the soil loss on a given site to less than 10 per cent of that of bare soil, the C factor is acknowledged as having more importance in reducing soil erosion than the P factors. Hence, agronomic practices which are less expensive, easy to adopt, and more environment friendly shall receive its due share in all soil and water conservation measures.

7) Shortage of green fodder is a big problem faced by livestock farmers. Considering the importance and predominance of mixed farming situations, and considering

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the soil binding property of fodder grasses, fodder production programmes shall be mandatory in all watershed development programmes. High yielding cultivars of Hybrid Napier (like *Co-3*, *Killikulam*-1), Guinea grass (like *Makueni*, TD-50, *Haritha*), Congo signal, Gamba grass, Buffel grass etc. are to be screened and evaluated for local suitability.

8) The selection of species for live fencing shall also be done more appropriately, and by considering the stakeholder preferences. As far as possible, emphasis shall be more on multi-purpose species with more bio mass production and better soil binding properties.

9) Women and landless households shall receive adequate emphasis and representation in the watershed programmes. Such vulnerable groups should not be by passed.

10) Inadequacy of scale of finance was stated as a major constraint by a sizeable number of participating farmers. Keeping in view of the high wage rate prevailing in the State, more realistic cost norms may be evolved for the various conservation measures, which were capital as well as labour intensive.

11) Quarrying, sandmining and conversion of wetlands results in irreparable damage to the ecosystem(Plates 15 and 16). It has adverse effect on watershed community, plants and animal resources. Though the local bodies were armed with statutory powers to check such activities, in reality it goes on unchecked for various reasons. Wetland conservation and checking indiscriminate sandmining and quarrying shall form an integral component of watershed management. These issues shall be a matter of great concern and be addressed properly.

To sum up, the watershed development programmes are not concerned merely with conserving soil and water resources *per se*. It shall result in the conservation, utilization and management of the natural resources in a sustainable, economically efficient and socially desirable manner so that there is improvement in the livelihood security of the participating community.

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